

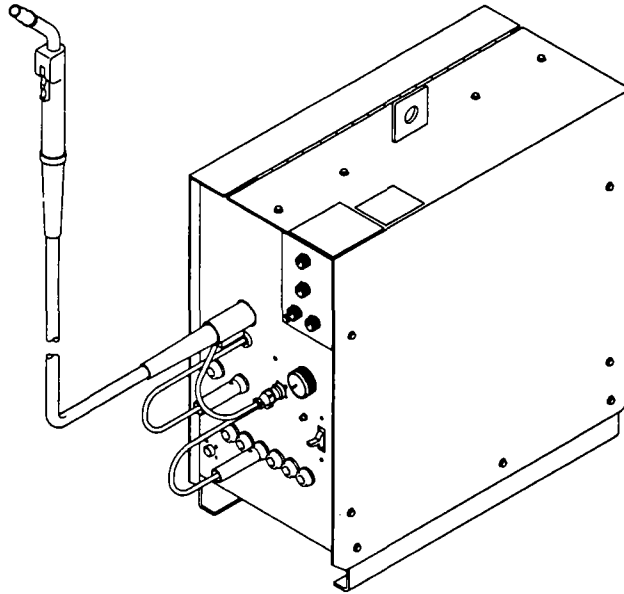


May 1991

FORM:OM-113 336D

Effective With Serial No. KA898403

**MODEL: AUTO ARC® MW 4150  
AUTO ARC® MW 4200  
SPW-1**



# OWNER'S MANUAL

**IMPORTANT:** Read and understand the entire contents of this manual, with special emphasis on the safety material throughout the manual, before installing, operating, or maintaining this equipment. This unit and these instructions are for use only by persons trained and experienced in the safe operation of welding equipment. Do not allow untrained persons to install, operate, or maintain this unit. Contact your distributor if you do not fully understand these instructions.

**MILLER ELECTRIC Mfg. Co.**  
A Miller Group Ltd., Company

P.O. Box 1079  
Appleton, WI 54912 USA  
Tel. 414-734-9821

# ONE YEAR LIMITED WARRANTY

EFFECTIVE: FEBRUARY 17, 1989

This warranty supersedes all previous AUTO ARC warranties and is exclusive with no other guarantees or warranties expressed or implied.

**COVERAGE** – MILLER Electric Mfg. Co. warrants to the buyer who purchases this AUTO ARC Welder ("Welder") for personal, family or household purposes ("Consumer") that this Welder will be free from defects in material and workmanship for a period of one year from the date of purchase. This warranty covers only the original purchaser of this Welder. MILLER Electric does not authorize any party, including its authorized distributors, to offer any other warranty on behalf of MILLER Electric. Upon expiration of the warranty period, MILLER Electric shall have no further liability related to the Welder, except on warranty claims made during the warranty period. No warranty is made by MILLER with respect to engines, trade accessories or other items manufactured by others. Such engines, trade accessories and other items are sold subject to the warranties of their respective manufacturers, if any. All engines are warranted by their manufacturer for two years from date of original purchase, except Deutz engines which have a one year, 2000 hour warranty.

MILLER shall be required to honor warranty claims on warranted Equipment in the event of failure resulting from a defect within the following periods from the date of delivery of Equipment to the original user:

1. Arc welders, power sources, and components . . . . 1 year
2. Original main power rectifiers . . . . . 3 years (labor – 1 year only)
3. All welding guns, feeder/guns and torches . . . . . 90 days
4. Replacement or repair parts, exclusive of labor . . 60 days
5. Batteries . . . . . 6 months

provided that MILLER is notified in writing within thirty (30) days of such failure.

**WHAT IS NOT COVERED** – This warranty does not extend to any Welder subjected to misuse, neglect, accident, or in-warranty repair by anyone except MILLER Electric or its authorized service stations. Further, this warranty only extends to the original purchaser of this Welder.

In the case of MILLER's breach of warranty or any other duty with respect to the quality of any goods, the exclusive remedies therefore shall be, at MILLER's option (1) repair or (2) replacement or, where authorized in writing by MILLER in appropriate cases, (3) the reasonable cost of repair or replacement at an authorized MILLER service station or (4) payment of or credit

for the purchase price (less reasonable depreciation based upon actual use) upon return of the goods at Consumer's risk and expense. MILLER's option of repair or replacement will be F.O.B., Factory at Appleton, WI or F.O.B. at a MILLER authorized service facility, therefore, no compensation for transportation costs of any kind will be allowed. Upon receipt of notice of apparent defect or failure, MILLER shall instruct the claimant on the warranty claim procedures to be followed.

THIS WARRANTY IS OFFERED IN LIEU OF ANY OTHER EXPRESS WARRANTY; AND, EXCEPT TO THE EXTENT PROHIBITED BY APPLICABLE LAW, THE DURATION OF ALL IMPLIED WARRANTIES, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, IS LIMITED TO THE DURATION OF THIS WARRANTY.

ANY EXPRESS WARRANTY NOT PROVIDED HEREIN AND ANY IMPLIED WARRANTY, GUARANTY OR REPRESENTATION AS TO PERFORMANCE, AND ANY REMEDY FOR BREACH OF CONTRACT WHICH, BUT FOR THIS PROVISION, MIGHT ARISE BY IMPLICATION, OPERATION OF LAW, CUSTOM OF TRADE OR COURSE OF DEALING, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR PARTICULAR PURPOSE, WITH RESPECT TO ANY AND ALL EQUIPMENT FURNISHED BY MILLER IS EXCLUDED AND DISCLAIMED BY MILLER.

Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

THE PURCHASER'S REMEDIES FOR A DEFECTIVE WELDER, TO THE EXTENT PERMITTED BY APPLICABLE LAW, ARE LIMITED TO THE REMEDY PROVIDED BY THIS WARRANTY. TO THE EXTENT ENFORCEABLE UNDER APPLICABLE LAW, MILLER ELECTRIC SHALL IN NO EVENT BE LIABLE FOR CONSEQUENTIAL, INCIDENTAL OR SPECIAL DAMAGES ARISING OUT OF THE USE OF, OR INABILITY TO USE, THE WELDER, WHETHER BASED ON BREACH OF THIS WARRANTY, MILLER ELECTRIC'S NEGLIGENCE OR OTHER TORT, OR ON ANY THEORY OF STRICT LIABILITY.

## ERRATA SHEET

After this manual was printed, refinements in equipment design occurred. This sheet lists exceptions to data appearing later in this manual.

### AMENDMENT TO SECTION 7 – MAINTENANCE & TROUBLESHOOTING

Amend Section 7-1A. ROUTINE MAINTENANCE: Fan Motor

This unit is equipped with an exhaust fan and relies on forced draft for adequate cooling. The fan motor needs oiling every six months using SAE 20 oil.



## RECEIVING-HANDLING

Before unpacking equipment, check carton for any damage that may have occurred during shipment. File any claims for loss or damage **with the delivering carrier**. Assistance for filing or settling claims may be obtained from the distributor and/or the equipment manufacturer's Transportation Department.

When requesting information about this equipment, always provide the Model Description and Serial or Style Number.

Use the following spaces to record the Model Designation and Serial or Style Number of your unit. The information is located on the data card or the nameplate.

Model \_\_\_\_\_

Serial or Style No. \_\_\_\_\_

Date of Purchase \_\_\_\_\_

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## SECTION 1 – SAFETY RULES FOR OPERATION OF ARC WELDING POWER SOURCE

### 1-1. INTRODUCTION

We learn by experience. Learning safety through personal experience, like a child touching a hot stove is harmful, wasteful, and unwise. Let the experience of others teach you.

Safe practices developed from experience in the use of welding and cutting are described in this manual. Research, development, and field experience have evolved reliable equipment and safe installation, operation, and servicing practices. Accidents occur when equipment is improperly used or maintained. The reason for the safe practices may not always be given. Some are based on common sense, others may require technical volumes to explain. It is wiser to follow the rules.

Read and understand these safe practices before attempting to install, operate, or service the equipment. Comply with these procedures as applicable to the particular equipment used and their instruction manuals, for personal safety and for the safety of others.

Failure to observe these safe practices may cause serious injury or death. When safety becomes a habit, the equipment can be used with confidence.

These safe practices are divided into two Sections: 1-General Precautions, common to arc welding and cutting; and 2-Arc Welding (and Cutting) (only).

Reference standards: Published Standards on safety are also available for additional and more complete procedures than those given in this manual. They are listed in the Standards Index in this manual. ANSI Z49.1 is the most complete.

The National Electrical Code, Occupational Safety and Health Administration, local industrial codes, and local inspection requirements also provide a basis for equipment installation, use, and service.

### 1-2. GENERAL PRECAUTIONS

**Different arc welding processes, electrode alloys, and fluxes can produce different fumes, gases, and radiation levels. In addition to the information in this manual, be sure to consult flux and electrode manufacturers Material Safety Data Sheets (MSDSs) for specific technical data and precautionary measures concerning their material.**

#### A. Burn Prevention

Wear protective clothing-gauntlet gloves designed for use in welding, hat, and high safety-toe shoes. Button shirt collar and pocket flaps, and wear cuffless trousers to avoid entry of sparks and slag.

Wear helmet with safety goggles and glasses with side shields underneath, appropriate filter lenses or plates (protected by clear cover glass). This is a MUST for

welding or cutting, (and chipping) to protect the eyes from radiant energy and flying metal. Replace cover glass when broken, pitted, or spattered. See 1-3A.2.

Avoid oily or greasy clothing. A spark may ignite them.

Hot metal such as electrode stubs and workpieces should never be handled without gloves.

Medical first aid and eye treatment. First aid facilities and a qualified first aid person should be available for each shift unless medical facilities are close by for immediate treatment of flash burns of the eyes and skin burns.

Ear plugs should be worn when working on overhead or in a confined space. A hard hat should be worn when others work overhead.

Flammable hair preparations should not be used by persons intending to weld or cut.

#### B. Toxic Fume Prevention

Severe discomfort, illness or death can result from fumes, vapors, heat, or oxygen enrichment or depletion that welding (or cutting) may produce. Prevent them with adequate ventilation as described in ANSI Standard Z49.1 listed in Standards Index. NEVER ventilate with oxygen.

Lead -, cadmium -, zinc -, mercury -, and beryllium-bearing and similar materials, when welded (or cut) may produce harmful concentrations of toxic fumes. Adequate local exhaust ventilation must be used, or each person in the area as well as the operator must wear an air-supplied respirator. For beryllium, both must be used.

Metals coated with or containing materials that emit toxic fumes should not be heated unless coating is removed from the work surface, the area is well ventilated and, if necessary, while wearing an air-supplied respirator.

Work in a confined space only while it is being ventilated and, if necessary, while wearing an air-supplied respirator.

Gas leaks in a confined space should be avoided. Leaked gas in large quantities can change oxygen concentration dangerously. Do not bring gas cylinders into a confined space.

Leaving confined space, shut OFF gas supply at source to prevent possible accumulation of gases in the space if downstream valves have been accidentally opened or left open. Check to be sure that the space is safe before re-entering it.

Vapors from chlorinated solvents can be decomposed by the heat of the arc (or flame) to form PHOSGENE, a highly toxic gas, and other lung and eye irritating products. The ultraviolet (radiant) energy of the arc can also decompose trichloroethylene and perchloroethylene vapors to form phosgene. DO NOT WELD or cut where solvent vapors can be drawn into the welding or cutting atmosphere or where the radiant energy can penetrate to

atmospheres containing even minute amounts of trichloroethylene or perchloroethylene.

### C. Fire and Explosion Prevention

Causes of fire and explosion are: combustibles reached by the arc, flame, flying sparks, hot slag or heated material; misuse of compressed gases and cylinders; and short circuits.

**BE AWARE THAT** flying sparks or falling slag can pass through cracks, along pipes, through windows or doors, and through wall or floor openings, out of sight of the goggled operator. Sparks and slag can fly 35 feet.

To prevent fires and explosion:

Keep equipment clean and operable, free of oil, grease, and (in electrical parts) of metallic particles that can cause short circuits.

If combustibles are in area, do NOT weld or cut. Move the work if practicable, to an area free of combustibles. Avoid paint spray rooms, dip tanks, storage areas, ventilators. If the work cannot be moved, move combustibles at least 35 feet away out of reach of sparks and heat; or protect against ignition with suitable and snug-fitting, fire-resistant covers or shields.

Walls touching combustibles on opposite sides should not be welded on (or cut). Walls, ceilings, and floor near work should be protected by heat-resistant covers or shields.

Fire watcher must be standing by with suitable fire extinguishing equipment during and for some time after welding or cutting if:

- a. appreciable combustibles (including building construction) are within 35 feet
- b. appreciable combustibles are further than 35 feet but can be ignited by sparks
- c. openings (concealed or visible) in floors or walls within 35 feet may expose combustibles to sparks
- d. combustibles adjacent to walls, ceilings, roofs, or metal partitions can be ignited by radiant or conducted heat.

Hot work permit should be obtained before operation to ensure supervisor's approval that adequate precautions have been taken.

After work is done, check that area is free of sparks, glowing embers, and flames.

An empty container that held combustibles, or that can produce flammable or toxic vapors when heated, must never be welded on or cut, unless container has first been cleaned as described in AWS Standard A6.0, listed 7 in Standards Index.

This includes: a thorough steam or caustic cleaning (or a solvent or water washing, depending on the combustible's solubility) followed by purging and inerting with nitrogen or carbon dioxide, and using protective equip-

ment as recommended in A6.0. Waterfilling just below working level may substitute for inerting.

A container with unknown contents should be cleaned (see preceding paragraph). Do NOT depend on sense of smell or sight to determine if it is safe to weld or cut.

Hollow castings or containers must be vented before welding or cutting. They can explode.

Explosive atmospheres. Never weld or cut where the air may contain flammable dust, gas, or liquid vapors (such as gasoline).

### D. Compressed Gas Equipment

Standard precautions. Comply with precautions in this manual, and those detailed in CGA Standard P-1, SAFE HANDLING OF COMPRESSED GASES IN CYLINDERS, listed 11 in Standards Index.

#### 1. Pressure Regulators

Regulator relief valve is designed to protect only the regulator from overpressure; it is not intended to protect any downstream equipment. Provide such protection with one or more relief devices.

Never connect a regulator to a cylinder containing gas other than that for which the regulator was designed.

Remove faulty regulator from service immediately for repair (first close cylinder valve). The following symptoms indicate a faulty regulator:

Leaks-if gas leaks externally.

Excessive Creep-if delivery pressure continues to rise with downstream valve closed.

Faulty Gauge-if gauge pointer does not move off stop pin when pressurized, nor returns to stop pin after pressure release.

Repair. Do NOT attempt to repair. Send faulty regulators for repair to manufacturer's designated repair center, where special techniques and tools are used by trained personnel.

#### 2. Cylinders

Cylinders must be handled carefully to prevent leaks and damage to their walls, valves, or safety devices:

Avoid electrical circuit contact with cylinders including third rails, electrical wires, or welding circuits. They can produce short circuit arcs that may lead to a serious accident. (See 1-3C.)

ICC or DOT marking must be on each cylinder. It is an assurance of safety when the cylinder is properly handled.

Identifying gas content. Use only cylinders with name of gas marked on them; do not rely on color to identify gas content. Notify supplier if unmarked. NEVER DEFACE or alter name, number, or other markings on a cylinder. It is illegal and hazardous.

Empties: Keep valves closed, replace caps securely; mark MT; keep them separate from FULLS and return promptly.

Prohibited use. Never use a cylinder or its contents for other than its intended use, NEVER as a support or roller.

Locate or secure cylinders so they cannot be knocked over.

Passageways and work areas. Keep cylinders clear of areas where they may be struck.

Transporting cylinders. With a crane, use a secure support such as a platform or cradle. Do NOT lift cylinders off the ground by their valves or caps, or by chains, slings, or magnets.

Do NOT expose cylinders to excessive heat, sparks, slag, and flame, etc. that may cause rupture. Do not allow contents to exceed 130°F. Cool with water spray where such exposure exists.

Protect cylinders particularly valves from bumps, falls, falling objects, and weather. Replace caps securely when moving cylinders.

Stuck valve. Do NOT use a hammer or wrench to open a cylinder valve that can not be opened by hand. Notify your supplier.

Mixing gases. Never try to mix any gases in a cylinder.

Never refill any cylinder.

Cylinder fittings should never be modified or exchanged.

### 3. Hose

Prohibited use. Never use hose other than that designed for the specified gas. A general hose identification rule is: red for fuel gas, green for oxygen, and black for inert gases.

Use ferrules or clamps designed for the hose (not ordinary wire or other substitute) as a binding to connect hoses to fittings.

No copper tubing splices. Use only standard brass fittings to splice hose.

Avoid long runs to prevent kinks and abuse. Suspend hose off ground to keep it from being run over, stepped on, or otherwise damaged.

Coil excess hose to prevent kinks and tangles.

Protect hose from damage by sharp edges, and by sparks, slag, and open flame.

Examine hose regularly for leaks, wear, and loose connections. Immerse pressured hose in water; bubbles indicate leaks.

Repair leaky or worn hose by cutting area out and splicing (1-2D3). Do NOT tape.

### 4. Proper Connections

Clean cylinder valve outlet of impurities that may clog orifices and damage seats before connecting regulator. Except for hydrogen, crack valve momentarily, pointing

outlet away from people and sources of ignition. Wipe with a clean lintless cloth.

Match regulator to cylinder. Before connecting, check that the regulator label and cylinder marking area, and that the regulator inlet and cylinder outlet match. NEVER CONNECT a regulator designed for a particular gas or gases to a cylinder containing any other gas.

Tighten connections. When assembling threaded connections, clean and smooth seats where necessary. Tighten. If connection leaks, disassemble, clean, and retighten using properly fitting wrench.

Adapters. Use a CGA adapter (available from your supplier) between cylinder and regulator, if one is required. Use two wrenches to tighten adapter marked RIGHT and LEFT HAND threads.

Regulator outlet (or hose) connections may be identified by right hand threads for oxygen and left hand threads (with grooved hex on nut or shank) for fuel gas.

### 5. Pressurizing Steps:

Drain regulator of residual gas through suitable vent before opening cylinder (or manifold valve) by turning adjusting screw in (clockwise). Draining prevents excessive compression heat at high pressure seat by allowing seat to open on pressurization. Leave adjusting screw engaged slightly on single-stage regulators.

Stand to side of regulator while opening cylinder valve.

Open cylinder valve slowly so that regulator pressure increases slowly. When gauge is pressurized (gauge reaches regulator maximum) leave cylinder valve in following position: For oxygen, and inert gases, open fully to seal stem against possible leak. For fuel gas, open to less than one turn to permit quick emergency shutdown.

Use pressure charts (available from your supplier) for safe and efficient, recommended pressure settings on regulators.

Check for leaks on first pressurization and regularly there-after. Brush with soap solution (capfull of Ivory Liquid\* or equivalent per gallon of water). Bubbles indicate leak. Clean off soapy water after test; dried soap is combustible.

### E. User Responsibilities

Remove leaky or defective equipment from service immediately for repair. See User Responsibility statement in equipment manual.

### F. Leaving Equipment Unattended

Close gas supply at source and drain gas.

### G. Rope Staging-Support

Rope staging-support should not be used for welding or cutting operation; rope may burn.

\*Trademark of Proctor & Gamble.

### 1-3. ARC WELDING

Comply with precautions in 1-1, 1-2, and this section. Arc Welding, properly done, is a safe process, but a careless operator invites trouble. The equipment carries high currents at significant voltages. The arc is very bright and hot. Sparks fly, fumes rise, ultraviolet and infrared energy radiates, weldments are hot, and compressed gases may be used. The wise operator avoids unnecessary risks and protects himself and others from accidents. Precautions are described here and in standards referenced in index.

#### A. Burn Protection

Comply with precautions in 1-2.

The welding arc is intense and visibly bright. Its radiation can damage eyes, penetrate lightweight clothing, reflect from light-colored surfaces, and burn the skin and eyes. Skin burns resemble acute sunburn, those from gas-shielded arcs are more severe and painful. **DON'T GET BURNED; COMPLY WITH PRECAUTIONS.**

##### 1. Protective Clothing

Wear long-sleeve clothing (particularly for gas-shielded arc) in addition to gloves, hat, and shoes (1-2A). As necessary, use additional protective clothing such as leather jacket or sleeves, flame-proof apron, and fire-resistant leggings. Avoid outer garments of untreated cotton.

Bare skin protection. Wear dark, substantial clothing. Button collar to protect chest and neck and button pockets to prevent entry of sparks.

##### 2. Eye and Head Protection

Protect eyes from exposure to arc. **NEVER** look at an electric arc without protection.

Welding helmet or shield containing a filter plate shade no. 12 or denser must be used when welding. Place over face before striking arc.

Protect filter plate with a clear cover plate.

Cracked or broken helmet or shield should **NOT** be worn; radiation can pass through to cause burns.

Cracked, broken, or loose filter plates must be replaced **IMMEDIATELY**. Replace clear cover plate when broken, pitted, or spattered.

Flash goggles with side shields **MUST** be worn under the helmet to give some protection to the eyes should the helmet not be lowered over the face before an arc is struck. Looking at an arc momentarily with unprotected eyes (particularly a high intensity gas-shielded arc) can cause a retinal burn that may leave a permanent dark area in the field of vision.

##### 3. Protection of Nearby Personnel

Enclosed welding area. For production welding, a separate room or enclosed bay is best. In open areas, surround the operation with low-reflective, non-combustible screens or panels. Allow for free air circulation, particularly at floor level.

Viewing the weld. Provide face shields for all persons who will be looking directly at the weld.

Others working in area. See that all persons are wearing flash goggles.

Before starting to weld, make sure that screen flaps or bay doors are closed.

#### B. Toxic Fume Prevention

Comply with precautions in 1-2B.

Generator engine exhaust must be vented to the outside air. Carbon monoxide can kill.

#### C. Fire and Explosion Prevention

Comply with precautions in 1-2C.

Equipment's rated capacity. Do not overload arc welding equipment. It may overheat cables and cause a fire.

Loose cable connections may overheat or flash and cause a fire.

Never strike an arc on a cylinder or other pressure vessel. It creates a brittle area that can cause a violent rupture or lead to such a rupture under rough handling.

#### D. Compressed Gas Equipment

Comply with precautions in 1-2D.

#### E. Shock Prevention

Exposed hot conductors or other bare metal in the welding circuit, or in ungrounded, electrically-HOT equipment can fatally shock a person whose body becomes a conductor. **DO NOT STAND, SIT, LIE, LEAN ON, OR TOUCH** a wet surface when welding, without suitable protection.

To protect against shock:

Wear dry insulating gloves and body protection. Keep body and clothing dry. Never work in damp area without adequate insulation against electrical shock. Stay on a dry duckboard, or rubber mat when dampness or sweat can not be avoided. Sweat, sea water, or moisture between body and an electrically HOT part or grounded metal reduces the electrical resistance, and could enable dangerous and possibly lethal currents to flow through the body.

A voltage will exist between the electrode and any conducting object in the work circuit. Examples of conducting objects include, but are not limited to, buildings, electrical tools, work benches, welding power source cases, workpieces, etc. **Never touch the electrode and any metal object unless the welding power source is off.**

##### 1. Grounding the Equipment

Arc welding equipment must be grounded according to the National Electrical Code, and the work must be grounded according to ANSI Z49.1 "Safety In Welding And Cutting."

When installing, connect the frames of each unit such as welding power source, control, work table, and water circulator to the building ground. Conductors must be adequate to carry ground currents safely. Equipment made

6. ANSI Standard Z49.2, FIRE PREVENTION IN THE USE OF CUTTING AND WELDING PROCESSES obtainable from the American National Standards Institute, 1430 Broadway, New York, NY 10018.
7. AWS Standard A6.0, WELDING AND CUTTING CONTAINERS WHICH HAVE HELD COMBUSTIBLES obtainable from the American Welding Society, 550 N.W. LeJeune Rd, Miami, FL 33126.
8. NFPA Standard 51, OXYGEN-FUEL GAS SYSTEMS FOR WELDING, CUTTING, AND ALLIED PROCESSES obtainable from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.
9. NFPA Standard 70, NATIONAL ELECTRICAL CODE obtainable from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.
10. NFPA Standard 51B, CUTTING AND WELDING PROCESSES obtainable from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.
11. CGA Pamphlet P-1, SAFE HANDLING OF COMPRESSED GASES IN CYLINDERS obtainable from the Compressed Gas Association, 1235 Jefferson Davis Highway, Suite 501, Arlington, VA 22202.
12. CSA Standard W117.2, CODE FOR SAFETY IN WELDING AND CUTTING obtainable from the Canadian Standards Association, Standards Sales, 178 Rexdale Boulevard, Rexdale, Ontario, Canada M9W 1R3.
13. NWSA booklet, WELDING SAFETY BIBLIOGRAPHY obtainable from the National Welding Supply Association, 1900 Arch Street, Philadelphia, PA 19103.
14. American Welding Society Standard AWSF4.1, RECOMMENDED SAFE PRACTICES FOR THE PREPARATION FOR WELDING AND CUTTING OF CONTAINERS AND PIPING THAT HAVE HELD HAZARDOUS SUBSTANCES, obtainable from the American Welding Society, 550 N.W. LeJeune Rd, Miami, FL 33126.
15. ANSI Standard Z88.2, PRACTICE FOR RESPIRATORY PROTECTION, obtainable from the American National Standards Institute, 1430 Broadway, New York, NY 10018.

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## SECTION 2 – SAFETY PRECAUTIONS AND SIGNAL WORDS

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### 2-1. GENERAL INFORMATION AND SAFETY

#### A. General

Information presented in this manual and on various labels, tags, and plates on the unit pertains to equipment design, installation, operation, maintenance, and troubleshooting which should be read, understood, and followed for the safe and effective use of this equipment.

The nameplate of this unit uses international symbols for labeling the front panel controls. The symbols also appear at the appropriate section in the text.

#### B. Safety

The installation, operation, maintenance, and troubleshooting of arc welding equipment requires practices and procedures which ensure personal safety and the safety of others. Therefore, this equipment is to be installed, operated, and maintained only by qualified persons in accordance with this manual and all applicable codes such as, but not limited to, those listed at the end of Section 1 – Safety Rules For Operation Of Arc Welding Power Source.

### 2-2. SAFETY ALERT SYMBOL AND SIGNAL WORDS

The following safety alert symbol and signal words are used throughout this manual to call attention to and identify different levels of hazard and special instructions.



This safety alert symbol is used with the signal words **WARNING** and **CAUTION** to call attention to the safety statements.



**WARNING** statements identify procedures or practices which must be followed to avoid serious personal injury or loss of life.



**CAUTION** statements identify procedures or practices which must be followed to avoid minor personal injury or damage to this equipment.

**IMPORTANT** statements identify special instructions necessary for the most efficient operation of this equipment.

electrically HOT by stray current may shock, possibly fatally. Do NOT GROUND to electrical conduit, or to a pipe carrying ANY gas or flammable liquid such as oil or fuel.

Three-phase connection. Check phase requirements of equipment before installing. If only 3-phase power is available, connect single-phase equipment to only two wires of the 3-phase line. Do NOT connect the equipment ground lead to the third (live) wire, or the equipment will become electrically HOT—a dangerous condition that can shock, possibly fatally.

Before welding, check ground for continuity. Be sure conductors are touching bare metal of equipment frames at connections.

If a line cord with a ground lead is provided with the equipment for connection to a switchbox, connect the ground lead to the grounded switchbox. If a three-prong plug is added for connection to a grounded mating receptacle, the ground lead must be connected to the ground prong only. If the line cord comes with a three-prong plug, connect to a grounded mating receptacle. Never remove the ground prong from a plug, or use a plug with a broken off ground prong.

## 2. Electrode Holders

Fully insulated electrode holders should be used. Do NOT use holders with protruding screws.

## 3. Connectors

Fully insulated lock-type connectors should be used to join welding cable lengths.

## 4. Cables

Frequently inspect cables for wear, cracks and damage. IMMEDIATELY REPLACE those with excessively worn or damaged insulation to avoid possibly-lethal shock from bared cable. Cables with damaged areas may be taped to give resistance equivalent to original cable.

Keep cable dry, free of oil and grease, and protected from hot metal and sparks.

## 5. Terminals And Other Exposed Parts

Terminals and other exposed parts of electrical units should have insulating covers secured before operation.

## 6. Electrode

### a. Equipment with output on/off control (contactor)

Welding power sources for use with the gas metal arc welding (GMAW), gas tungsten arc welding (GTAW) and similar processes normally are equipped with devices that permit on-off control of the welding power output. When so equipped the electrode wire becomes electrically HOT when the power source switch is ON and the welding gun switch is closed. Never touch the electrode wire or any conducting object in contact with the electrode circuit unless the welding power source is off.

### b. Equipment without output on/off control (no contactor)

Welding power sources used with shielded metal arc welding (SMAW) and similar processes may not be equipped with welding power output on-off control devices. With such equipment the electrode is electrically HOT when the power switch is turned ON. Never touch the electrode unless the welding power source is off.

## 7. Safety Devices

Safety devices such as interlocks and circuit breakers should not be disconnected or shunted out.

Before installation, inspection, or service, of equipment, shut OFF all power and remove line fuses (or lock or red-tag switches) to prevent accidental turning ON of power. Disconnect all cables from welding power source, and pull all 115 volts line-cord plugs.

Do not open power circuit or change polarity while welding. If, in an emergency, it must be disconnected, guard against shock burns, or flash from switch arcing.

Leaving equipment unattended. Always shut OFF and disconnect all power to equipment.

Power disconnect switch must be available near the welding power source.

## F. Protection For Wearers of Electronic Life Support Devices (Pacemakers)

Magnetic fields from high currents can affect pacemaker operation. Persons wearing electronic life support equipment (pacemaker) should consult with their doctor before going near arc welding, gouging, or spot welding operations.

## 1-4. STANDARDS BOOKLET INDEX

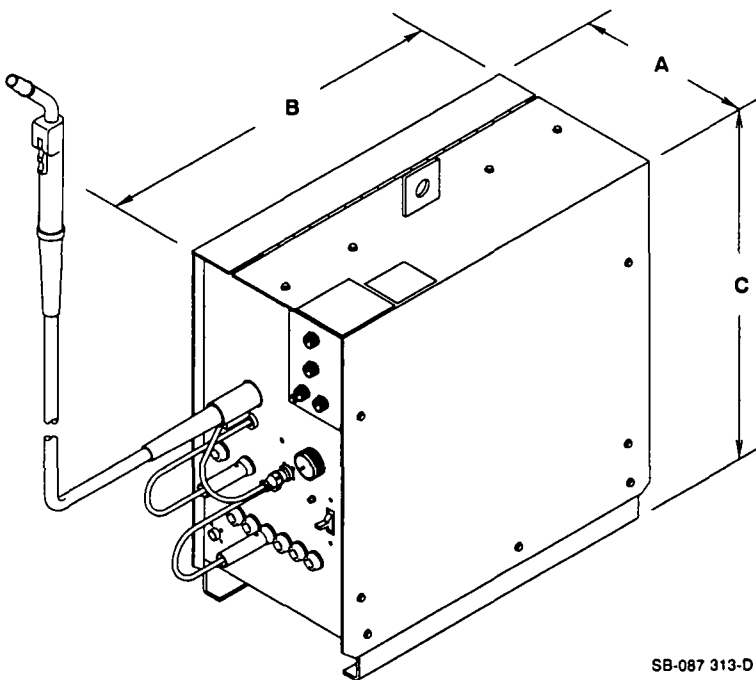
For more information, refer to the following standards or their latest revisions and comply as applicable:

1. ANSI Standard Z49.1, SAFETY IN WELDING AND CUTTING obtainable from the American Welding Society, 550 N.W. LeJeune Rd, Miami, FL 33126.
2. NIOSH, SAFETY AND HEALTH IN ARC WELDING AND GAS WELDING AND CUTTING obtainable from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
3. OSHA, SAFETY AND HEALTH STANDARDS, 29CFR 1910, obtainable from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
4. ANSI Standard Z87.1, SAFE PRACTICES FOR OCCUPATION AND EDUCATIONAL EYE AND FACE PROTECTION obtainable from the American National Standards Institute, 1430 Broadway, New York, NY 10018.
5. ANSI Standard Z41.1, STANDARD FOR MEN'S SAFETY-TOE FOOTWEAR obtainable from the American National Standards Institute, 1430 Broadway, New York, NY 10018.

## SECTION 3 – SPECIFICATIONS

Table 3-1. Specifications

Rated Weld Output At 60% Duty Cycle	Max. Open-Circuit Voltage	Input At Rated Load Output 60 Hz Single-Phase						Control Circuit Voltage At Gun	Electrode Wire Feed Speed	Electrode Wire Diameter Capability
		Amperes At				kva	kw			
		200V	230V	460V	575V					
150 Amperes At 23Volts DC	32	26.5	24	12	9.6	5.5	4.8	24 Volts DC	60 to 486 ipm (1.5 to 12.3 mpm)	.023/.025 in. (0.6 mm) .030 in. (0.8 mm) .035 in. (0.9 mm)



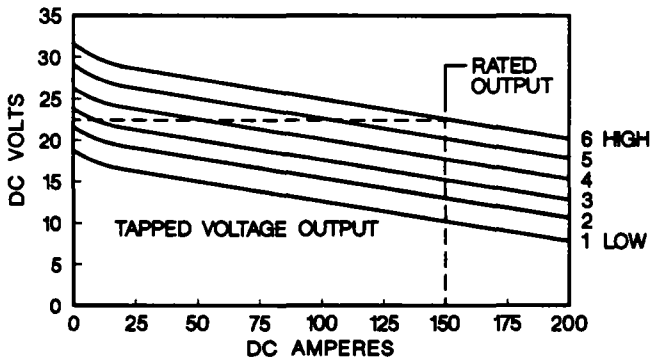
Dimensions	Weight	
	Net	Ship
A: Width 13-1/2 in. (343 mm)	205 lbs.* (93 kg)	215 lbs.** (98 kg)
B: Length 27 in. (686 mm)		
C: Height 30 in. (762 mm)		

\*Add 2-3/4 lbs. (1.25 kg) for units with spot panel.  
 \*\*Add 5 lbs. (2.27 kg) for units with spot panel.

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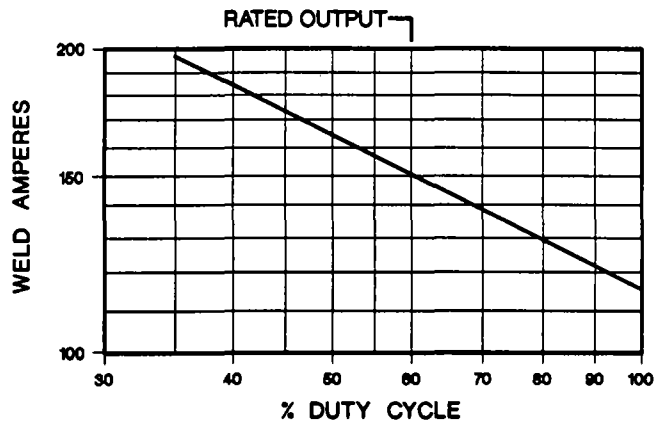
Figure 3-1. Overall Dimensions

Chart 3-1. Volt-Ampere Curves



SB-146 888

Chart 3-2. Duty Cycle



SB-146 887

### 3-1. VOLT-AMPERE CURVES (Chart 3-1)



The volt-ampere curves show the voltage and amperage output capabilities of the unit. Voltage and amperage adjustment is provided by the FINE TUNING WIRE SPEED control. Curves of other setting fall between the curves shown.

With the use of the volt-ampere curves, it is possible to determine the weld amperage at any particular load voltage.

### 3-2. DUTY CYCLE (Chart 3-2)

The duty cycle is the percentage of a ten minute period that a welding power source can be operated at a given output without overheating and damaging the unit. This welding power source is rated at 60 percent duty cycle when operated at 150 amperes. The unit can be operated at 150 amperes for six consecutive minutes, but it must operate at no load for the remaining four minutes to allow proper cooling. If the welding amperes decrease, the duty cycle increases.

Refer to the Duty Cycle chart (Chart 3-2) to determine the output of the welding power source at various duty cycles.

 **CAUTION: EXCEEDING DUTY CYCLE RATINGS will damage the welding power source.**

- Do not exceed indicated duty cycles.

### 3-3. DESCRIPTION

This unit is a single-phase constant voltage dc arc welding power source and wire feeder system. This unit is designed for Gas Metal Arc Welding (GMAW) with short circuit or spray transfer. It is designed primarily for use as a dc Electrode Positive/Reverse Polarity machine. Rated weld output is 150 amperes, 23 volts dc, at 60% duty cycle.

Models with the optional SPOT/PULSE WELD PANEL provide the controls for regulating spot weld time/pulse on time, burnback time, and pulse off time.

### 3-4. SUPPLIED EQUIPMENT (Figure 3-2)

The following equipment is supplied with the welding power source and requires customer installation or assembly:

- A. Running gear with gas cylinder rack and bracket.
- B. Wall receptacle (200/230 volt models only).
- C. Work cable, work clamp, and jack plug.
- D. MWG-200 gun with 5/8 in. (16 mm) nozzle and two contact tubes for each wire size.
- E. Drive rolls for .023/.025, .030, and .035 in. (0.6, 0.8, and 0.9 mm) hard wire.

The welding power source is factory equipped with 9 ft. (2.7 m) power cord (with plug on 200/230 volt models), gas valve, and facilities for a Spool gun.

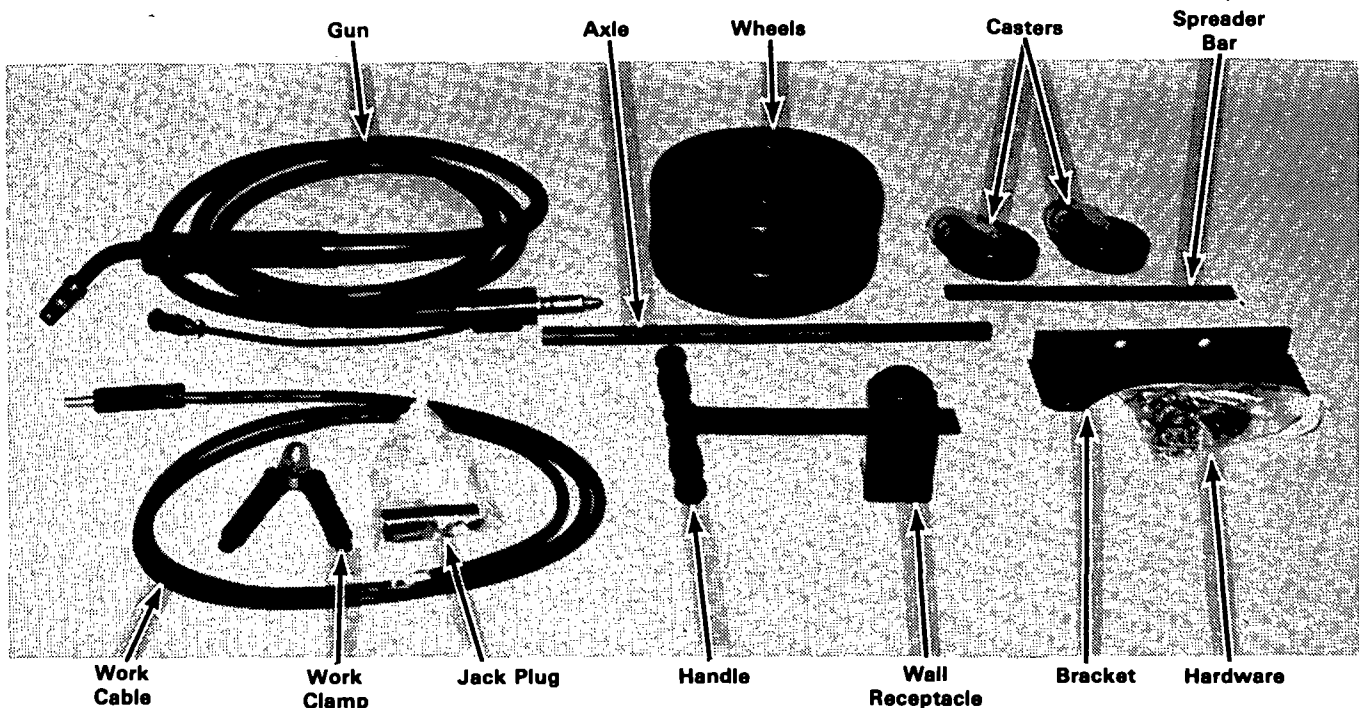


Figure 3-2. Supplied Equipment



### 3-5. ADDITIONAL REQUIRED EQUIPMENT (Figure 3-3)

The additional equipment required to complete the Gas Metal Arc Welding (GMAW) setup can be obtained from your local welding supplies distributor.

#### A. Gas Cylinder

Two types of gas are generally used with Gas Metal Arc Welding (GMAW) of thin gauge sheet steel. Carbon dioxide (CO<sub>2</sub>) is the gas recommended for use with this welding power source/gun combination. A mixture of 75 percent argon and 25 percent carbon dioxide also gives favorable results. Obtain a cylinder of selected shielding gas from your supplier.

#### B. Regulator/Flowmeter

Regulator/flowmeters provide a constant shielding gas pressure and flow rate during the welding process. Because gases have different properties, each regulator/flowmeter is designed to be used with a specific gas or mixture of gases. Regulator/flowmeters cannot be changed from one gas to another unless the proper adapters are installed. Obtain the proper regulator/flowmeter for the type of gas used.

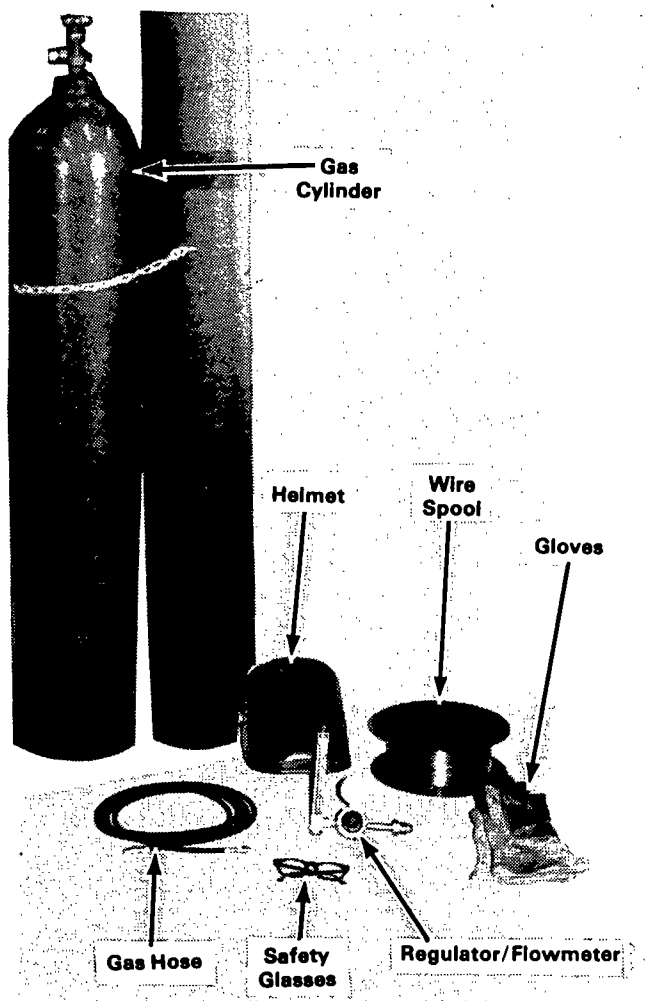


Figure 3-3. Additional Required Equipment

#### C. Gas Hose

Measure distance from gas cylinder to welding power source. Obtain good quality 5/8 in. (16 mm) outside diameter, S.A.E. gas hose, and install 5/8-18 right-hand thread fittings on both ends of hose.

#### D. Wire Spool For GMAW Process

Selection of the correct welding wire is important in Gas Metal Arc Welding (GMAW). There are many types to choose from, but certain wires are best suited for welding thin gauge sheet steel. The American Welding Society (AWS) classification for GMAW wires is usually indicated on the label of the wire spool. Two AWS wire classes recommended are E70S-6 and E70S-3. The E70S-6 provides a more fluid (wetter) weld puddle and a flatter bead than E70S-3. Obtain a spool of selected wire.

#### E. Personal Safety Equipment

When using this welding power source, wear a welding helmet, fitted with the proper filter lens, to protect the eyes from the welding arc. Also wear protective clothing, safety glasses, and gloves to prevent injury.

#### F. Offset/Punching Tool (Figure 3-4)

The repair of automotive sheet steel is easier when an Offset/Punching tool is used. This tool has a dual purpose, rotating head.

The damaged area is cut away and the jaws of the offset portion of the head are placed over the sheet steel. When pressure is applied to the handles, the tool indents a small offset in the sheet steel. A new piece of sheet steel, cut to size, is placed in position to overlap the offset portion. The new piece of sheet steel is welded into place, sanded, filled with body putty, and finish sanded.

The head of the tool can be rotated one-half turn to be used as a punching tool. The punching tool expedites riveting operations. The use of this tool will keep material use and finishing time to a minimum.

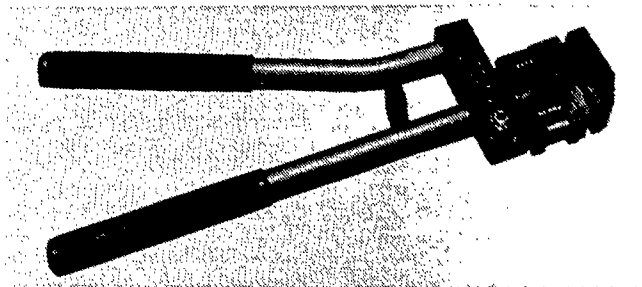


Figure 3-4. Offset/Punching Tool

### 3-6. OPTIONAL EQUIPMENT

The following equipment can be obtained to extend the capabilities of the basic unit or to suit special applications:

- A. SPW-1, Spot, Pulse, Continuous Panel (includes three spot nozzles) (for installation see Section 4-4)
- B. Spool gun
- C. Gun cable holder
- D. 25 ft. (7.6 m) power cord extension.

### 3-7. CONSUMABLE PARTS

The following parts are subject to wear or damage in normal use:

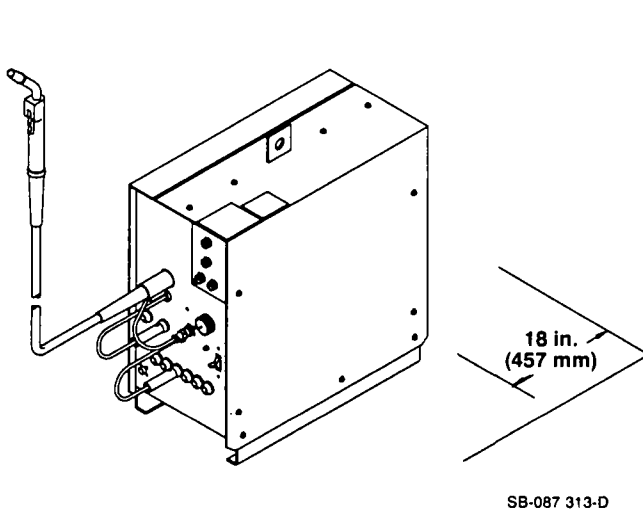
- A. Contact tubes
- B. Nozzles
- C. Gun liner
- D. Drive rolls.

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## SECTION 4 – INSTALLATION OR RELOCATION

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### 4-1. SITE SELECTION (Figure 4-1)



**Figure 4-1. Location**

Select an installation site which provides the following:

1. Correct input power supply (see unit nameplate)
2. Shielding gas supply
3. Adequate ventilation and fresh air supply
4. No flammables
5. A clean and dry area
6. Proper temperature that avoids extremes of heat or cold
7. Proper airflow around unit
8. Adequate space for opening side access doors for installation, maintenance, and repair functions.

Base mounting holes provide the capability to install and secure the unit on a running gear or in a permanent location.



**WARNING: FIRE OR EXPLOSION** can result from placing unit on or over combustible surfaces; **RESTRICTED AIRFLOW** can cause overheating and possible damage to internal parts.

- Do not locate unit over combustible surfaces.
- Maintain at least 18 inches (457 mm) of unrestricted space on all sides of unit, and keep underside free of obstructions.
- Do not place any filtering device over the intake air passages that provide airflow for cooling this unit.

Warranty is void if any type of filtering device is used at intake air passages.

### 4-2. TRANSPORTING METHODS

This welding power source is equipped with a lifting eye for moving the unit during installation. Weight capacity of the lifting eye only allows for supporting the welding power source.



**WARNING: ELECTRIC SHOCK** can kill.

- Do not touch live electrical parts.
- Disconnect input power conductors from deenergized supply line **BEFORE** moving welding power source.

**FALLING EQUIPMENT** can cause serious personal injury and equipment damage.

- Use lifting eye to lift unit only, **NOT** running gear, gas cylinders, or any other heavy accessories or devices.
- Use equipment of adequate capacity to lift the unit.
- If lifting or moving this unit with lift forks under the base, be sure that lift forks are long enough to extend beyond opposite side of the base.

Using lift forks too short can damage internal parts if tips of the lift forks penetrate the unit base, or may cause personal injury and/or equipment damage if unit falls off the lift forks.

#### 4-3. RUNNING GEAR INSTALLATION (Figure 4-2)



**WARNING: UNCONTROLLED TILTING OR TIPPING** of unit can result in personal injury or equipment damage.

- Use equipment of adequate capacity to lift the unit.
- If using lift forks to handle this unit, be sure the lift forks are long enough to extend out of the opposite side of the base.
- Do not place any part of the body under the unit while it is suspended.

Place blocks under frame of unit before installing running gear.

1. Install the two 4 in. (102 mm) casters and spreader bar onto the front corners of the welding power source base as shown in Figure 4-2 using 3/8 in. hardware.
2. Block the unit up securely in middle to ease installation of rear wheel/gas cylinder rack assembly.
3. Slide axle through cylinder rack, and install a wheel on each end of axle with a 3/4 in. flat washer on each side of wheel.
4. Secure wheels in place with supplied retaining rings.

5. Install cylinder rack onto welding power source base using 5/16-18 x 3/4 cap screws and associated hardware (see Figure 4-2).
6. Remove the two front cap screws in top of welding power source wrapper and discard. Install running gear handle onto wrapper using 1/4-20 x 3/4 cap screws as shown in Figure 4-2.
7. Install cylinder bracket onto rear panel of welding power source as shown in Figure 4-2 using 1/4-20 x 3/4 cap screws and existing holes in rear panel.
8. Install safety chain onto cylinder bracket.

#### 4-4. OPTIONAL SPW-1 PANEL INSTALLATION (Figure 4-3)



**WARNING: ELECTRIC SHOCK** can kill.

- Do not touch live electrical parts.
- Shut down welding power source, and disconnect input power employing lockout/tagging procedures before inspecting or installing.

Lockout/tagging procedures consist of removing input power plug from receptacle, padlocking line disconnect switch in open position, removing fuses from fuse box, or shutting off and red-tagging circuit breaker or other disconnecting device.

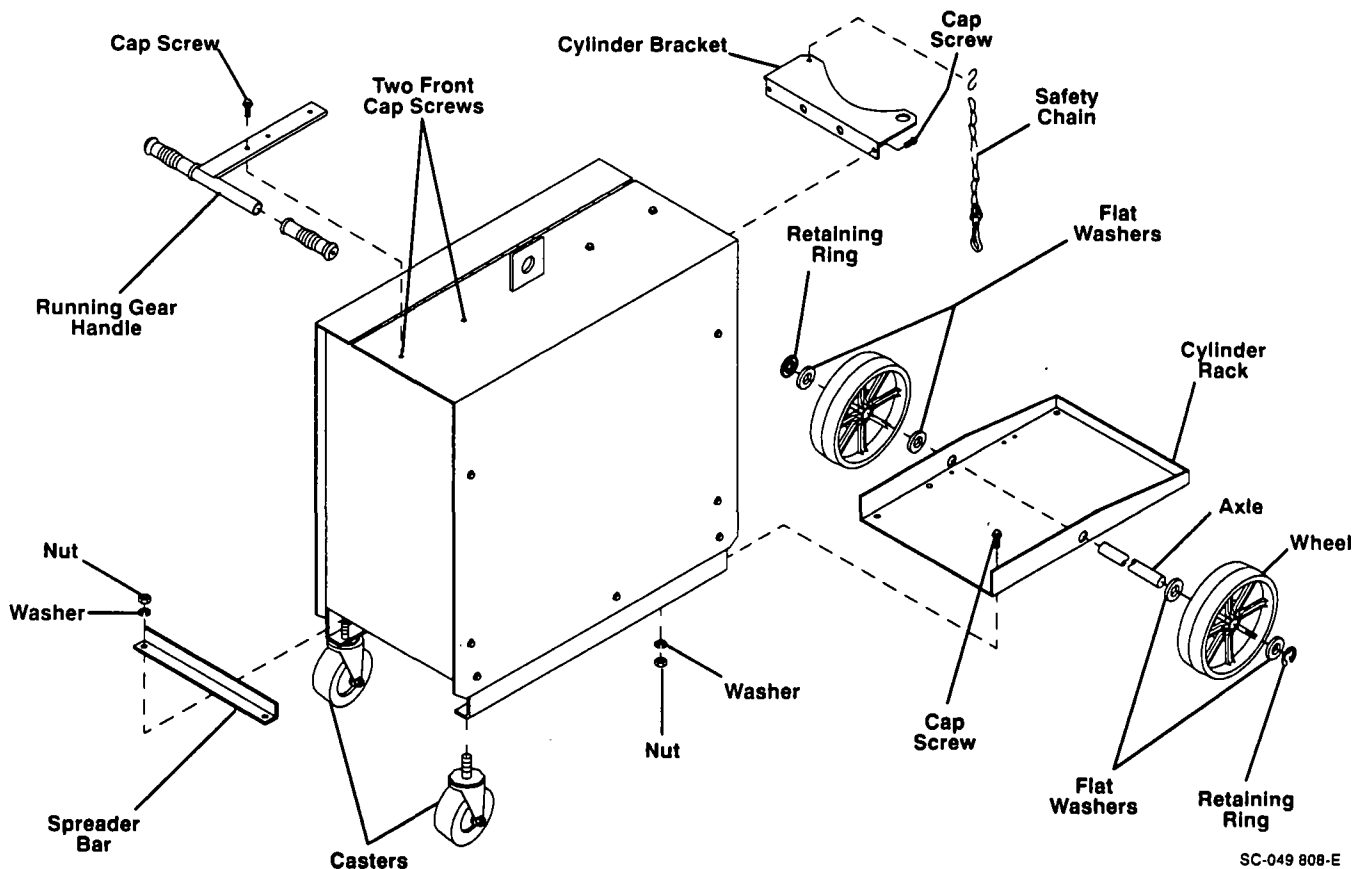


Figure 4-2. Running Gear Installation

**IMPORTANT:** *SPW-1 Spot Panel will not provide spot capabilities for the Spool gun. Retain all hardware removed during this procedure for reinstallation. All directions, such as left or right, are with respect to the operator facing the front panel.*

1. Remove module cover plate from upper right-hand corner of front panel.
2. Locate wiring harness clamped to air baffle. Remove wiring harness from first clamp and carefully pull end of wiring harness with connectors through opening in front panel – it will come through approximately 2 in. (51 mm).
3. Disconnect jumpered connector from plug PLG2.
4. Connect receptacle RC55 from SPW-1 panel to PLG2. Be sure the connectors are locked together (see Figure 4-3).
5. Install SPW-1 panel into upper right corner of front panel, and secure using screws removed in Step 1.

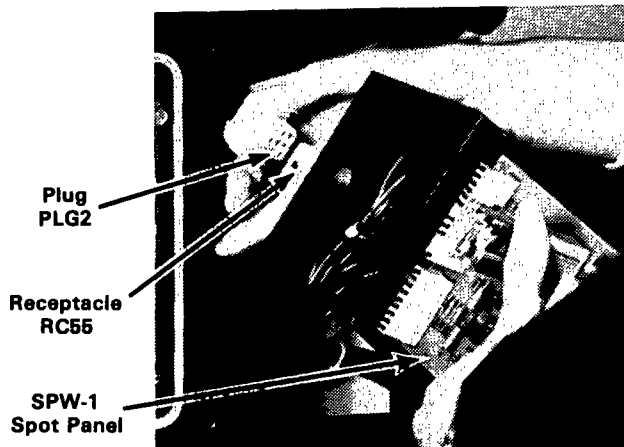


Figure 4-3. SPW-1 Panel Installation

#### 4-5. SHIELDING GAS INSTALLATION

##### A. Gas Cylinder (Customer Supplied) (Figure 3-3)

Secure gas cylinder to running gear using safety chain on cylinder bracket. If the running gear is not to be used, chain cylinder to wall or other stationary support to prevent the cylinder from falling over and breaking off the valve.



**WARNING:** **PRESSURIZED CYLINDERS** can rupture causing serious personal injury and loss of life; **FALLING CYLINDERS** can cause serious injury and equipment damage.

- Keep cylinders away from welding or other electrical circuits.
- Never allow a welding electrode to touch any cylinder.
- Always fasten cylinder securely to running gear bracket, a wall, or other stationary support.

##### B. Regulator/Flowmeter (Customer Supplied) (Figure 4-4)

1. With the cylinder correctly installed, remove cylinder cap (see Figure 4-4). Stand to one side of the cylinder valve, and open the valve slightly. When gas flows from cylinder, close valve. This procedure gets rid of any dust or dirt that may have accumulated around the valve seat.
2. The regulator/flowmeter must be properly equipped with a stem, nut connectors, and gasket for use with either CO<sub>2</sub> cylinders or Argon/CO<sub>2</sub> cylinders.

**IMPORTANT:** *A gasket should be installed to prevent leaks. Do not use lubricants or sealing agents.*

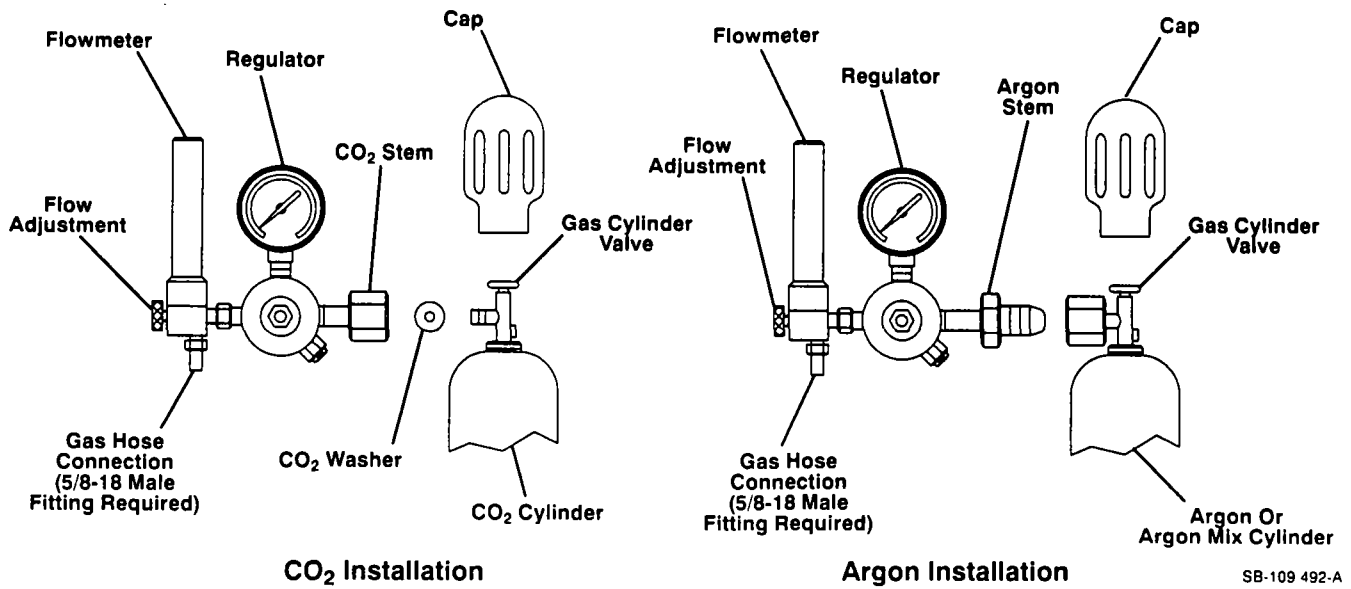
3. Install gas regulator onto gas cylinder valve; keep the face of the regulator/flowmeter gauge in the vertical position, and tighten stem nut securely onto gas cylinder.
4. A shielding gas output fitting is provided at the rear of the welding power source for making gas connections. Attach one end of the gas hose to this output fitting. Attach other end of the gas hose to the regulator/flowmeter.

#### 4-6. WORK CABLE ASSEMBLY

A 10 ft. (3 m) cable with a lug attached to one end is supplied with the unit. To install the work clamp and jack plug onto the cable, proceed as follows:

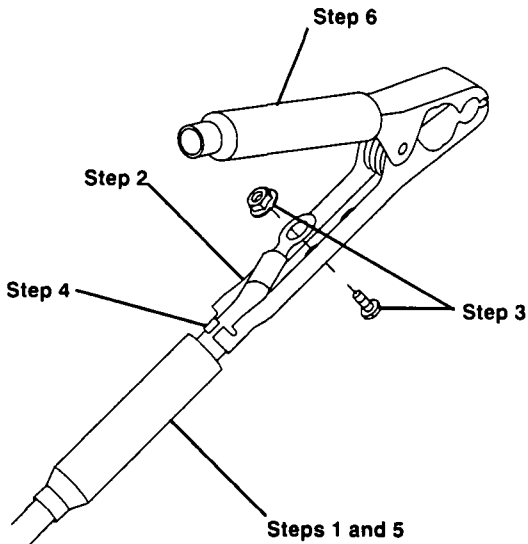
##### A. Work Clamp Installation (Figure 4-5)

1. Insert the end of the work cable with the terminal lug on it through one of two supplied insulating sleeves.
2. Lay the work cable inside the handle of the work clamp which has the flattest inner surface.
3. Align the smaller hole in the work clamp handle with the hole in the work cable terminal lug. Secure the terminal lug to the work clamp with the supplied nut and bolt.
4. Bend the tabs on the end of the work clamp handle around the work cable.
5. Slide the insulating sleeve on the work cable over the work clamp handle.



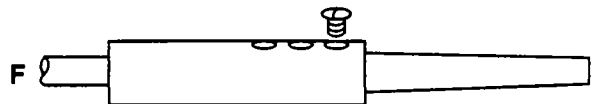
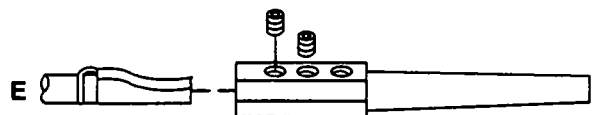
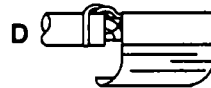
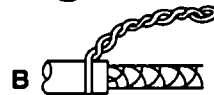
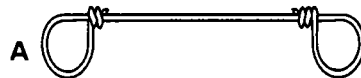
**Figure 4-4. Typical Regulator/Flowmeter Installation**

- Slide the remaining insulating sleeve over the other work clamp handle.



**Figure 4-5. Work Clamp Installation**

- Insert a 3/8 in. (9.5 mm) diameter rod through looped ends of tie wire.
- Twist tie wire (B) until entire tie wire is twisted and is tight around insulation of cable.
- Cut off looped ends of tie wire.
- Bend the twisted tie wire over and along the side (C) of uninsulated portion of cable.
- Wrap the strip of copper foil tightly around uninsulated portion of cable and twisted tie wire (D).
- Push the jack plug onto cable over copper foil (E).



**B. Jack Plug Installation (Figure 4-6)**

The supplied jack plugs are used to connect the weld cables to the weld output receptacles. Install jack plugs onto weld cables as follows:

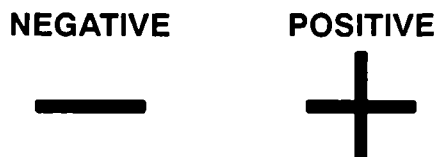
- Remove 3/4 in. (19 mm) of insulation from one end of each weld cable.
- Clamp cable in a vise with the uninsulated end extending upward out of vise approximately 1-3/4 in. (44 mm).
- Place steel tie wire (item A, Figure 4-6) approximately 1/4 in. (6 mm) from end of insulation.
- Make a half turn around cable bringing looped ends of tie wire together.

**Figure 4-6. Jack Plug Installation**

S-0023

11. Insert the 1/4-20 setscrews into center and bottom holes in jack plug, and tighten (E).
12. Remove cable from vise, and insert jack plug into insulating sleeve. Slide insulating sleeve over jack plug and cable until hole in insulating sleeve lines up with remaining hole in jack plug (F).
13. Insert the 8-32 self-tapping screw (F) through hole in insulating sleeve into jack plug, and tighten.

#### 4-7. WELD POLARITY SELECTION



 **WARNING: ELECTRIC SHOCK can kill; ARCING can burn skin or damage electrical connections.**

- Do not touch live electrical parts.
- Shut down welding power source before making any twistlock plug connections.
- Do not change position of twistlock plug while welding.
- Secure twistlock plug in selected receptacle before welding.

**IMPORTANT:** Rotate jack plugs 1/4 turn clockwise to secure them in receptacles.

1. Connect jack plug on weld cable from unit into POSITIVE (+) weld output receptacle.
2. Connect jack plug from work cable into NEGATIVE (-) weld output receptacle.

**IMPORTANT:** For Electrode Negative/Straight Polarity Connections, reverse cable connections to weld output receptacles; electrode becomes negative.

#### 4-8. MWG-200 WELDING GUN CONNECTIONS

 **WARNING: ELECTRIC SHOCK can kill.**

- Do not touch live electrical parts.
- Shut down welding power source, and disconnect input power employing lockout/tagging procedures before inspecting or installing.

Lockout/tagging procedures consist of removing input power plug from receptacle, padlocking line disconnect switch in open position, removing fuses from fuse box, or shutting off and red-tagging circuit breaker or other disconnecting device.

#### A. Gun/Feeder Connector Installation (Figures 4-7 And 4-8)

**IMPORTANT:** The outlet guide is provided as part of the gun assembly.

1. Open access door.
2. Loosen the gun/feeder connector securing knob (see Figure 4-7).

**IMPORTANT:** Wire guides should be installed so that the tip of the guide is as close to the drive rolls as possible without touching.

3. Insert the gun/feeder connector, which includes outlet guide, through the access hole in the welding power source front panel and into the drive assembly as illustrated in Figures 4-7 and 4-8.
4. Tighten the gun/feeder connector securing knob.
5. Close and secure access door.

#### B. Gun Switch Connection (Figure 4-8)



The GUN TRIGGER receptacle is provided for making switch control connections. Align the keys on the gun switch connector with the keyway on the GUN TRIGGER receptacle, insert connector, and rotate threaded collar fully clockwise. When the gun switch is closed, the welding power source contactor energizes, shielding gas flows, and wire feeds.

#### 4-9. INSTALLATION OF OPTIONAL SPOOL GUN

 **WARNING: ELECTRIC SHOCK can kill.**

- Do not touch live electrical parts.
- Do not connect two guns to this welding power source at the same time.
- Shut down welding power source, and disconnect input power employing lockout/tagging procedures before inspecting or installing.

Lockout/tagging procedures consist of removing input power plug from receptacle, padlocking line disconnect switch in open position, removing fuses from fuse box, or shutting off and red-tagging circuit breaker or other disconnecting device.

If two guns are connected to this welding power source, both electrode wires will be energized when either gun is operated.

#### A. Shielding Gas Connections

**IMPORTANT:** Use pure argon shielding gas for aluminum wire welding.

Connect the shielding gas hose from the Spool Gun to the gas regulator/flowmeter on the shielding gas supply. The connector has 5/8-18 right-hand threads.

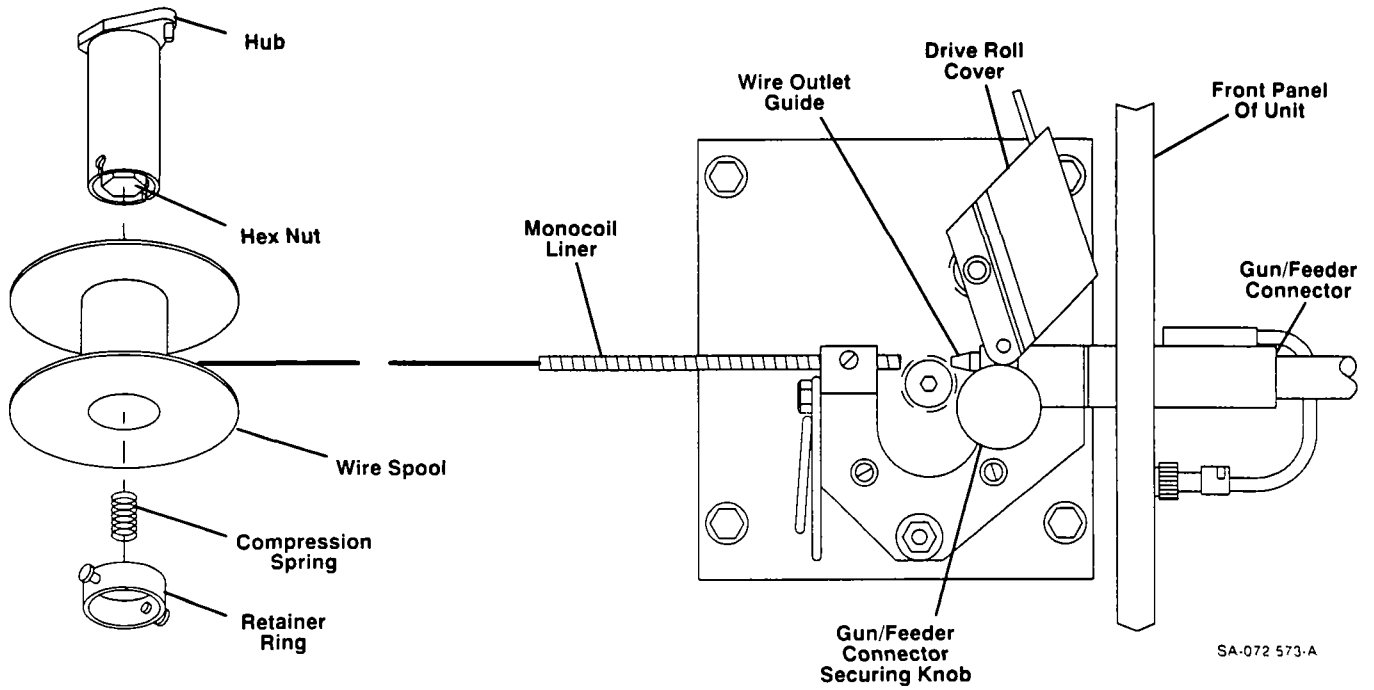
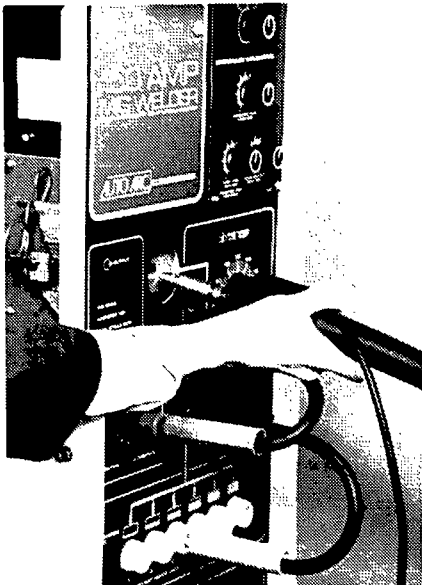
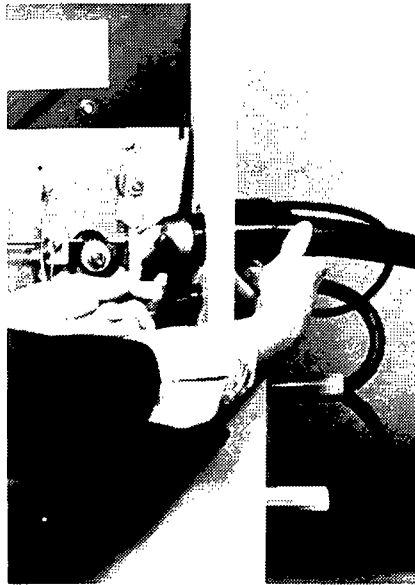


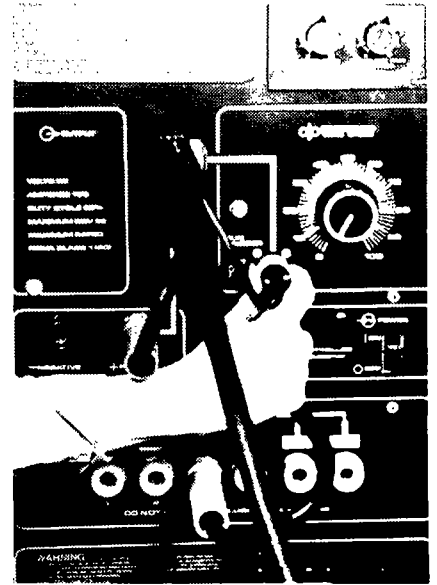
Figure 4-7. Gun/Feeder Connector And Wire Spool Installation



A



B



C

Figure 4-8. Welding Gun Connections

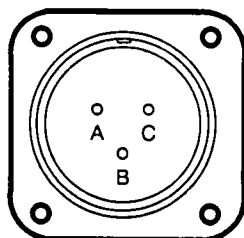
## B. Weld Cable Connections

Insert Spool Gun welding cable plug into POSITIVE (+) weld output receptacle with flat side facing the receptacle key. Rotate plug clockwise 1/4 turn.

## C. SPOOL GUN Receptacle Connection (Figure 4-9)



A 3-socket SPOOL GUN receptacle RC3 is provided for making connections between the welding power source and the Spool Gun. To connect the gun, align keyway, insert gun plug into receptacle, and rotate threaded collar fully clockwise. When gun switch is closed, the contactor energizes, shielding gas flows, and wire feeds.



S-0037

**Figure 4-9. Front View Of 3-Socket Spool Gun Receptacle With Socket Locations**

The sockets on the SPOOL GUN receptacle are designated as follows:

Socket A: +24 volts ac, 60 Hz.

Socket B: Welding power source contactor control; +24 volts closes contactor; 0 volts opens contactor.

Socket C: +24 volts ac, 60 Hz.

## 4-10. WELDING WIRE SPOOL INSTALLATION (Figure 4-7)



**WARNING: ELECTRIC SHOCK can kill.**

- Do not touch live electrical parts.
- Shut down welding power source, and disconnect input power employing lockout/tagging procedures before inspecting or installing.

Lockout/tagging procedures consist of removing input power plug from receptacle, padlocking line disconnect switch in open position, removing fuses from fuse box, or shutting off and red-tagging circuit breaker or other disconnecting device.

1. Open left side access door.
2. Remove retaining ring.

3. Slide spool of wire onto hub so that wire feeds off bottom of spool.
4. Rotate spool until hole in spool aligns with pin in hub. Slide spool onto hub until it seats against back flange of hub.
5. Compression spring is not required for 12 in. (305 mm) spools. For 8 in. (203 mm) spools, use compression spring. Reinstall retaining ring onto hub.
6. Close and secure access door.

## 4-11. HUB TENSION ADJUSTMENT (Figure 4-7)



**WARNING: ELECTRIC SHOCK can kill.**

- Do not touch live electrical parts.
- Shut down welding power source, and disconnect input power employing lockout/tagging procedures before inspecting or installing.

Lockout/tagging procedures consist of removing input power plug from receptacle, padlocking line disconnect switch in open position, removing fuses from fuse box, or shutting off and red-tagging circuit breaker or other disconnecting device.

Check the hub tension by slowly pulling the wire toward the feed roll. The wire should unwind freely, but the hub tension should be sufficient to keep the wire taut and prevent backlash when the wire feeding ceases. If adjustment is required, loosen or tighten the hex nut on the end of the spindle support shaft accordingly.

## 4-12. ELECTRICAL INPUT CONNECTIONS



**WARNING: ELECTRIC SHOCK can kill.**

- Do not touch live electrical parts.
- Shut down welding power source, and disconnect input power employing lockout/tagging procedures before inspecting or installing.

Lockout/tagging procedures consist of removing input power plug from receptacle, padlocking line disconnect switch in open position, removing fuses from fuse box, or shutting off and red-tagging circuit breaker or other disconnecting device.

## A. Electrical Input Requirements

Operate the welding power source from a single-phase, 60 Hertz, ac power supply. The input voltage must match one of the electrical input voltages shown on the input data label on the unit nameplate. Contact the local electric utility for information about the type of electrical service available, how proper connections should be made, and inspection required.



## B. Jumper Link Installation (Figures 4-10 And 4-11)



**WARNING:** Read and follow safety information at beginning of entire Section 4-12 before proceeding.

Jumper links are used to allow the equipment to operate from different line voltages. The jumper links may be in a bag attached to the input terminal board or installed on the input terminal board for the highest voltage shown on the input voltage label.

1. Remove the wrapper.
2. Compare position of jumper links on the input terminal board (see Figure 4-10) to the voltage link arrangement on input voltage label (see Figure 4-11).

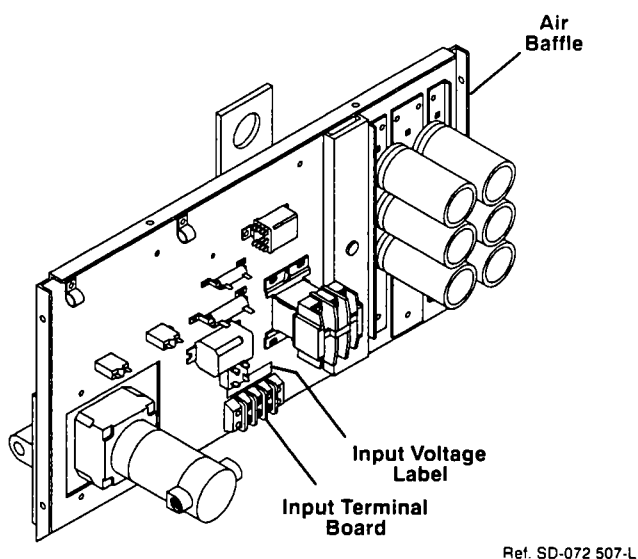


Figure 4-10. Input Terminal Board Location



**CAUTION: INCORRECT INPUT VOLTAGE JUMPER LINK PLACEMENT** can damage unit.

- Position jumper links as shown on the input voltage label (see Figures 4-10 and 4-11).
- Store unused jumper links across linked terminals.

**IMPORTANT:** If the input voltages stated on nameplate or rating label are different from those in Figure 4-11, check the input voltage label in the unit or call Factory Service Department.

3. Install jumper links onto the input terminal board to match the available input line voltage.
4. Reinstall wrapper.

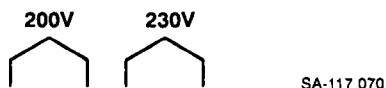


Figure 4-11. Input Voltage Label

## C. Wall Receptacle And Power Cable Connections (Figure 4-12)



**WARNING: ELECTRIC SHOCK** can kill.

- Do not touch live electrical parts.
- Install a fusible line disconnect switch in the input circuit to the welding power source.

Use Table 4-1 as a guide in selecting appropriate input conductor and fuse size.

- Connect input conductors to the welding power source before connecting to single-phase input power.
- Read and follow safety information at beginning of entire Section 4-12 before proceeding.

The line disconnect switch provides a safe and convenient means to completely remove all electrical power from the welding power source whenever necessary to inspect or service unit.

All models are equipped with a three-conductor power cable. Models requiring 200 or 230 volts input are equipped with a three-prong polarized plug and wall receptacle. The wall receptacle should be installed in a convenient location by a competent electrician. Install the wall receptacle with the grounding terminal at the top, allowing the power cable to hang downward without undue bending or twisting.

Models having an electrical input voltage above 230 volts have prewired power cables with three conductors. The black and white conductors must be connected to the line disconnect switch, and the green conductor must be connected to a proper ground (see Figure 4-12). Use a grounding method that is acceptable to the local electrical inspection authority.

Table 4-1. Input Conductor And Fuse Size\*

Input Voltage	200	230	460	575
Input Conductor Size (AWG)	10	10	14	14
Ground Conductor Size (AWG)	10	10	14	14
Fuse Size In Amperes	40	35	20	15

\*Conductor size is based on the 1990 Edition of the National Electrical Code (NEC) specifications for allowable ampacities of insulated copper conductors, having a temperature rating of 167°F (75°C), with not more than three single current-carrying conductors in a raceway (Article 310 of NEC). (The ground conductor is not counted as a current-carrying conductor.)

\*Fuse size is based on not more than 200 percent of the rated input amperage of the welding power source (Article 630 of NEC).

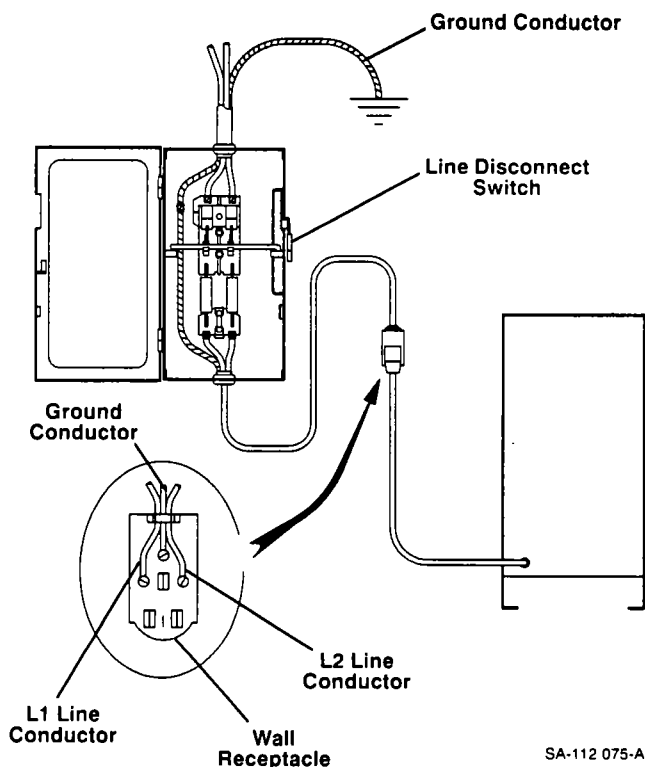
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**WARNING: ELECTRIC SHOCK can kill.**

- Do not connect an input (white or black) conductor to the ground terminal.
- Do not connect the ground (green) conductor to an input line terminal.

Incorrect input connections can result in an electrically energized welding power source chassis. The ground terminal is connected to the welding power source chassis and is for grounding purposes only.



**Figure 4-12. Wall Receptacle And Power Cable Connections**

**4-13. WELDING WIRE THREADING (Figure 4-7)**



**WARNING: ELECTRIC SHOCK can kill; MOVING PARTS can cause serious injury.**

- Do not touch live electrical parts.
- Keep away from moving parts.
- Do not energize welding power source or wire feeder until instructed to do so.

The welding wire and all metal parts in contact with it are energized while welding.

**WELDING WIRE can cause puncture wounds; HOT SURFACES can cause severe burns.**

- Do not press gun trigger until instructed to do so.
- Do not point gun toward any part of the body, any conductive surface, or other personnel when threading welding wire.
- Allow gun to cool before touching.

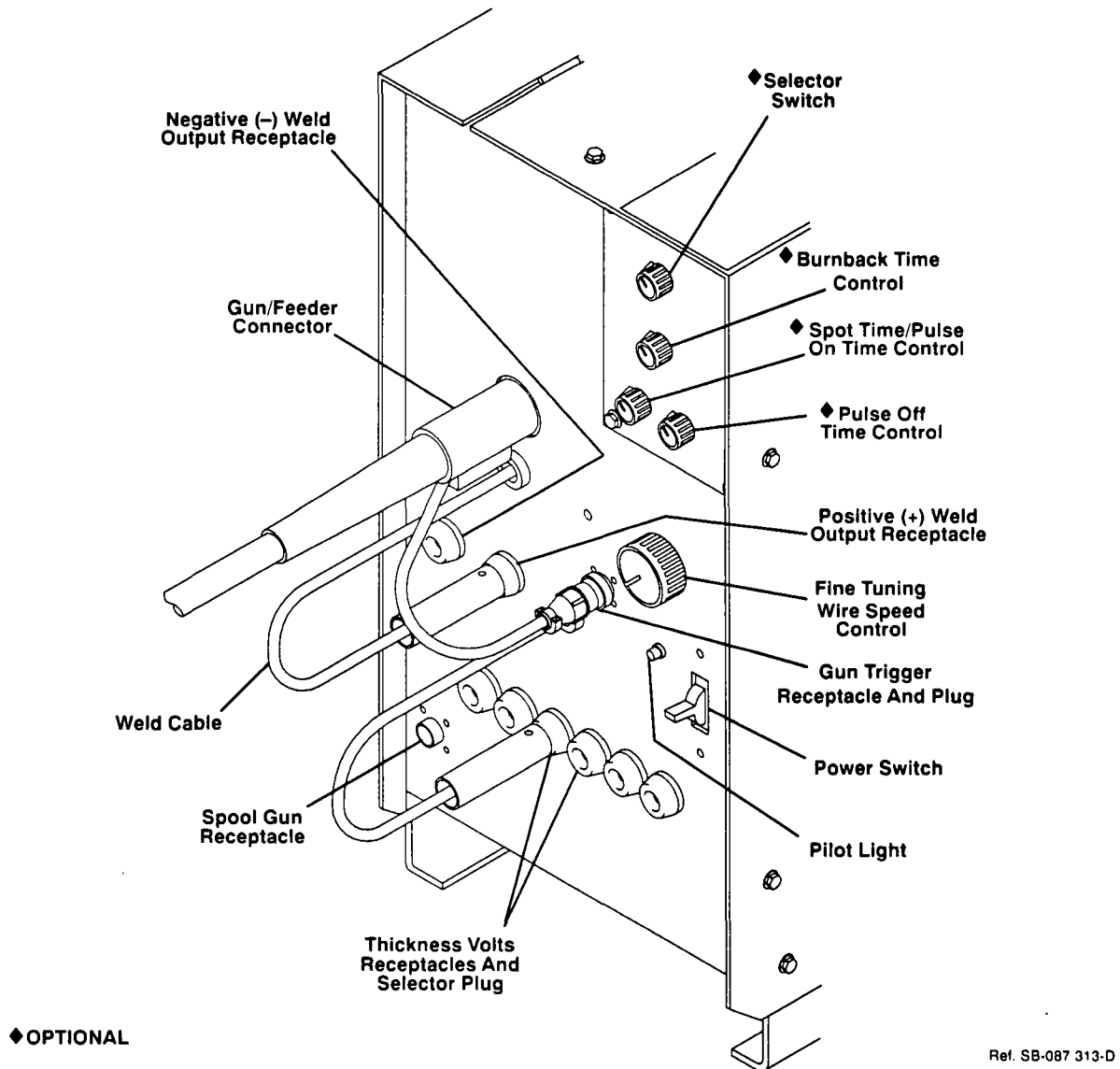
1. Open left side access door.
2. Install welding wire spool according to Section 4-10.

**IMPORTANT: Spooled wire has a tendency to unravel when loosened from the spool. Maintain a firm grip on the wire during the threading operation.**

3. Unreel and straighten approximately 6 in. (152 mm) of wire from wire spool.
4. Cut off any wire that is bent, and remove any burrs or sharp edges.
5. Release pressure spring on drive roll assembly, and pivot upper drive roll up and away from lower drive roll.
6. Route welding wire into wire inlet guide, along lower drive roll groove, and into wire outlet guide (see Figure 4-7).
7. Pivot upper drive roll down onto lower drive roll.
8. Reinstall pressure spring. Be sure that welding wire is in groove of drive rolls.
9. Lay gun cable assembly out as straight and flat as possible.
10. Energize welding power source. If power source has spot welding capabilities, place the Selector switch in the CONTINUOUS position.
11. Depress and hold the gun trigger until the wire feeds approximately 1/4 in. (6 mm) out the gun nozzle. If wire feeds more than 1/4 in. out nozzle, cut wire off to 1/4 in.
12. Deenergize welding power source.
13. Adjust hub tension according to Section 4-11, if necessary.
14. Close and secure access door.

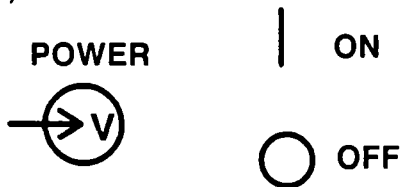
**IMPORTANT: For a smoother weld start, be sure welding wire extends 1/4 in. (6 mm) out of contact tube and has a sharp end.**

## SECTION 5 – OPERATOR CONTROLS



**Figure 5-1. Operator Controls**

**5-1. POWER SWITCH AND PILOT LIGHT (Figure 5-1)**



Placing the POWER switch in the ON position energizes the welding power source. The pilot light comes on whenever the POWER switch is in the ON position and indicates that the unit is receiving input power.

Placing the POWER switch in the OFF position shuts down the welding power source and turns off the pilot light.

**IMPORTANT:** When the POWER switch is in the ON position, the pilot light comes on, but the fan motor does not run unless the internal components are already warm. The fan motor is thermostatically controlled and only operates when additional cooling is required (see Section 5-4).

**5-2. THICKNESS VOLTS SELECTOR (Figure 5-1)**

### THICKNESS VOLTS



**CAUTION: ARCING** can damage jack plug and receptacle contact surfaces.

- Do not change THICKNESS VOLTS selector plug position while welding or under load.

Arcing causes the contact surfaces to become pitted. Eventually continuity is lost and the selector plug no longer works to select output range.

The THICKNESS VOLTS selector jack plug and receptacles provide a selection of heat input to the weld. The higher the numbered receptacle, the hotter the weld.

**IMPORTANT:** After installing selector plug into THICKNESS VOLTS receptacle, rotate plug 1/4 turn clockwise to secure in place. When removing plug from receptacle, rotate plug 1/4 turn counterclockwise while withdrawing it from receptacle.

### 5-3. FINE TUNING WIRE SPEED CONTROL (Figure 5-1)



The FINE TUNING WIRE SPEED control provides selection of the speed at which welding wire feeds into the weld. Rotating the FINE TUNING WIRE SPEED control clockwise increases wire feed speed.

The scale around the FINE TUNING WIRE SPEED control is calibrated in percent and does not indicate the actual wire feed speed.

**IMPORTANT:** The FINE TUNING WIRE SPEED control may be adjusted while welding.

**IMPORTANT:** In the PULSE mode, the FINE TUNING WIRE SPEED control must be set at 50 percent or less when using THICKNESS VOLTS taps 5 and 6.

### 5-4. FAN-ON-DEMAND™

The fan motor is thermostatically controlled and does not turn on with the unit POWER switch. The fan motor runs when main transformer T1 and/or rectifier assembly SR3 are warm. Under normal loading, the fan motor may not run. The fan motor turns off when T1 and SR3 are cool or when the unit POWER switch is turned off.

Normally-open thermostats TP1 and TP2, and relay CR2 control the fan motor.

### 5-5. OPTIONAL SPOT/PULSE PANEL CONTROLS (Figure 5-1)

**IMPORTANT:** In the PULSE mode, the FINE TUNING WIRE SPEED control must be set at 50 percent or less. Exceeding the 50 percent control setting may trip the circuit breaker in the motor control circuit stopping wire feed.

#### A. Selector Switch

The Selector switch enables the operator to select continuous, spot, or pulsed wire feed operation.

1. Continuous Position

#### CONTINUOUS



Placing Selector switch in CONTINUOUS position and depressing the gun trigger feeds welding wire for as long as the gun trigger remains closed.

2. Spot Position

#### SPOT



Placing Selector switch in SPOT position and depressing the gun trigger feeds welding wire for the length of time set on the SPOT TIME control.

3. Pulse Position

#### PULSE



Placing Selector switch in PULSE position and depressing the gun trigger feeds welding wire for the length of time set on the PULSE ON TIME control. At the end of the pulse on time, welding wire stops feeding for the length of time set on the PULSE OFF TIME control. The welding wire continues to pulse feed on and off for the selected times until the gun trigger is released. The pulse option provides better control of the heat input to the weld on thin gauge metals, thereby decreasing distortion and the likelihood of melt-throughs.

#### B. Spot Time/Pulse On Time Control

The SPOT TIME/PULSE ON TIME control enables the operator to select from 0.5 to 4 seconds of pulse time for spot operation or 0.25 to 2 seconds for pulse operation. Rotating the control clockwise increases spot/pulse on time. The control scale is calibrated in percent and does not indicate actual spot/pulse on time.

#### C. Pulse Off Time Control

The PULSE OFF TIME control enables the operator to select from 0.25 to 1 second of pulse off time for pulse operation. Rotating the control clockwise increases pulse off time. The control scale is calibrated in percent and does not indicate actual pulse off time.

#### D. Burnback Time Control



#### BURNBACK TIME

The BURNBACK TIME control provides a means of adjusting the time period (up to a maximum of 0.25 seconds) that the welding wire remains electrically energized after the wire feeding has stopped.

By adjusting this control properly, the welding wire will neither freeze in the weld puddle nor in the contact tube of the gun. If the welding wire freezes to the work, increase the burnback time. If the welding wire burns back into the contact tube, decrease the burnback time. Rotate the control clockwise to increase the burnback time, and rotate the control counterclockwise to decrease the burnback time. The scale surrounding the control is calibrated in percent and does not represent an actual burnback time.

## SECTION 6 – SEQUENCE OF OPERATION



**WARNING: ELECTRIC SHOCK can kill; MOVING PARTS can cause serious injury; IMPROPER AIRFLOW AND EXPOSURE TO ENVIRONMENT can damage internal parts.**

- Do not touch live electrical parts.
- Keep away from moving parts.
- Keep all covers and panels in place while operating.

Warranty is void if the welding power source is operated with any portion of the outer enclosure removed.

**ARC RAYS, SPARKS, AND HOT SURFACES can burn eyes and skin; NOISE can damage hearing.**

- Wear correct eye, ear, and body protection.

**FUMES AND GASES can seriously harm your health.**

- Keep your head out of the fumes.
- Ventilate to keep from breathing fumes and gases.
- If ventilation is inadequate, use approved breathing device.

**WELDING WIRE can cause puncture wounds.**

- Do not point gun toward any part of the body, any conductive surface, or other personnel.

**HOT METAL, SPATTER, AND SLAG can cause fire and burns.**

- Watch for fire.
- Keep a fire extinguisher nearby, and know how to use it.
- Do not use near flammable material.
- Allow work and equipment to cool before handling.

**MAGNETIC FIELDS FROM HIGH CURRENTS can affect pacemaker operation.**

- Wearers should consult their doctor before going near arc welding, gouging, or spot welding operations.

See Section 1 - Safety Rules For Operation Of Arc Welding Power Source for basic welding safety information.

### 6-1. GAS METAL ARC WELDING (GMAW)-CONTINUOUS AND GAS METAL ARC WELDING-PULSED ARC (GMAW-P)



**WARNING: Read and follow safety information at beginning of entire Section 6 before proceeding.**

1. Install and connect unit according to section 4.

**IMPORTANT: Be sure that work cable is installed into NEGATIVE (-) weld output receptacle and weld cable from unit is installed into POSITIVE (+) weld output receptacle (see Section 4-7).**

2. Wear dry insulating gloves and clothing.
3. Thoroughly clean joint area of workpiece.



**CAUTION: WELDING CURRENT can damage vehicle computers and other electronic components.**

- Disconnect both battery cables before welding on a vehicle.
- Disconnect vehicle computer(s) before welding on a vehicle.
- Place work clamp as close to the weld as possible to avoid long electrical paths.
- Be sure all weld circuit connections are clean and tight.

4. Connect work clamp to clean, bare metal at workpiece.
5. Select and obtain proper welding wire, and thread as instructed in Section 4-13 of this Manual.
6. If applicable, place the Selector switch on the optional SPW-1 Panel in the CONTINUOUS position if continuous welding, and place the switch in the PULSE position if pulse welding (see Section 5-5).
7. If pulse welding, rotate the SPOT TIME/PULSE ON TIME and PULSE OFF TIME control to desired settings (see Section 5-5).
8. Set a voltage condition with the THICKNESS VOLTS selector plug that is appropriate for the base metal thickness and type of shielding gas (see Section 5-2 and Table 6-1).

**IMPORTANT: It is important that the selected voltage be appropriate for type of weld and thickness of material. Be sure that the weld bead is thoroughly fused with the base metal along the total length of the bead. If the weld bead does not penetrate the base metal, increase the weld voltage. If the edges of the bead cut into the base metal, decrease weld voltage.**

9. Rotate the FINE TUNING WIRE SPEED control to 50. The control can be adjusted as required while welding.
10. Turn on shielding gas at the source.
11. Adjust shielding gas pressure, and purge shielding gas hose as follows:
  - a. Open left side access door, release pressure spring on drive roll assembly, and pivot upper drive roll up and away from lower drive roll.

**Table 6-1. Suggested Parameters For Continuous Gas Metal Arc Welding (GMAW)**

Voltage Adjustment Receptacle		1	2	3	4	5	6
Metal Thickness	Gauges	22-18	18-16	16-14	14-12	12-10	10 or Heavier
	Inches	.035+	.047+	.059+	.067+	.104+	.134+
	Millimeters	.8+	1.2+	1.5+	1.9+	2.6+	3.4+
*Amperage For .030 in. (0.8 mm) Wire		30-55	55-85	85-105	105-130	130-150	150-180
*Amperage for .035 in. (0.9 mm) Wire		35-65	65-95	95-115	115-140	140-180	175-220

\*Amperage values are obtained by adjusting the FINE TUNING WIRE SPEED Control.



**WARNING: ELECTRIC SHOCK can kill.**

- Do not touch live electrical parts.
- Do not touch welding wire or any metal part in contact with it while welding.

The welding wire and all metal parts in contact with it carry weld current whenever the gun trigger is depressed.

- Energize welding power source, and depress gun trigger for approximately 15 seconds to adjust regulator/flowmeter and to purge the gas hose.

**IMPORTANT:** Shielding gas flow rate of 15 to 25 cfh is typical. Welding out of position at high wire feed speeds or welding in a drafty environment will require more shielding gas.

- Deenergize welding power source.
  - Close drive roll housing as follows:
    - Pivot upper drive roll down onto lower drive roll, and reinstall pressure spring.
  - Close and secure side access door.
- Wear welding helmet with proper filter lens according to ANSI Z49.1.
  - Energize welding power source.
  - Be sure welding wire extends approximately 1/4 in. (6 mm) out gun nozzle, position gun over joint, lower welding helmet, and depress gun trigger.

**IMPORTANT:** The welding wire is not energized until the gun trigger is pressed; therefore, the operator can accurately position gun on weld joint before lowering helmet and pressing gun trigger.

- Readjust FINE TUNING WIRE SPEED control as necessary.

**IMPORTANT:** Adjust the wire speed to keep weld spatter at a minimum while maintaining a steady, quick-

cracking sounding arc. (When optimum arc length is reached, arc will sound like frying bacon).

- If pulse welding, readjust SPOT TIME/PULSE ON TIME and PULSE OFF TIME control as necessary.

**6-2. GAS METAL ARC WELDING (GMAW)-SPOT (Models With Optional SPW-1 Panel Only)**



**WARNING: Read and follow safety information at beginning of entire Section 6 before proceeding.**

- Install and connect unit according to Section 4.

**IMPORTANT:** Be sure the work cable is installed into NEGATIVE (-) weld output receptacle and weld cable from unit is installed into POSITIVE (+) weld output receptacle (see Section 4-7).

- Wear dry insulating gloves and clothing.



**CAUTION: WELDING CURRENT can damage vehicle computers and other electronic components.**

- Disconnect both battery cables before welding on a vehicle.
- Disconnect vehicle computer(s) before welding on a vehicle.
- Place work clamp as close to the weld as possible to avoid long electrical paths.
- Be sure all weld circuit connections are clean and tight.

- Connect work clamp to clean, bare metal at workpiece.
- Select and obtain proper welding wire, and thread as instructed in Section 4-13 of this manual.
- Set spot weld parameters (weld voltage, wire feed speed, spot weld time, burnback time) as follows:
  - Obtain sample piece of metal the same type, but approximately twice the thickness of final workpiece, and clean surface to be welded.

- b. Place Selector Switch on optional SPW-1 panel in CONTINUOUS position, and set welding voltage and wire feed speed parameters according to Steps 8 thru 15 in Section 6-1. (Set voltage and wire feed speed for metal thickness of sample metal.)

**IMPORTANT:** Use in CONTINUOUS position serves as coarse adjustment of unit for SPOT mode operation. Arc length and weld puddle can not be observed with spot welding nozzle installed on gun. Several pieces of double thickness metal may be required to coarse adjust unit.

- c. After voltage and wire feed speed parameters have been set, deenergize welding power source, remove continuous welding nozzle from gun, and replace nozzle with appropriate spot welding nozzle.
- d. Obtain sample pieces of metal the same type and thickness of final workpiece.
- e. Place welding power source in SPOT mode, and rotate SPOT TIME/PULSE ON TIME and BURNBACK TIME controls to desired settings.

**IMPORTANT:** The correct burnback time allows the wire to burn back just free of the weld puddle. If the welding wire freezes to the workpiece at the end of the weld cycle, increase burnback time. If the welding wire burns back into the contact tube, decrease burnback time. If the wire burns back into the contact tube, it may be necessary to replace the contact tube in the gun. (See gun Owner's Manual for contact tube replacement procedure.)

- f. Make several practice spot welds to determine if weld parameters are set correctly. (Refer to Table 6-2 to check sample weld.)

To spot weld, place gun nozzle directly on workpiece, hold gun motionless, and depress gun trigger. When trigger is depressed, welding wire and shielding gas will feed for the length of time set on the SPOT TIME/PULSE ON TIME Control.

**IMPORTANT:** The welding wire is not energized until the gun trigger is pressed; therefore, the operator can accurately position gun on weld joint before lowering helmet and pressing gun trigger.

**IMPORTANT:** The gun trigger must be held closed until the SPOT TIME/PULSE ON TIME control has timed out, completing the spot weld cycle. If the trigger is released before the cycle is complete, the cycle stops, and the unit resets for another weld cycle.

- 6. After all weld parameters have been set, prepare weld joint (see Sections 9 and 10), and weld final workpiece.

**6-3. SHUTTING DOWN**

- 1. Stop welding.
- 2. Shut down welding power source.
- 3. Turn off shielding gas at the source.



**WARNING: HIGH CONCENTRATION OF SHIELDING GAS can harm health or kill.**

- Shut off gas supply when not in use.

**Table 6-2. Checking Weld Parameters**

Weld Appearance	Cause	Correction Procedure
Dark blue circle or small protrusion visible on reverse side of weld.	Voltage and wire feed speed parameters are set correctly.	None.
Small burn-through on reverse side of weld.	Voltage and wire feed speed parameters are set correctly, but spot time too long.	Decrease SPOT TIME/PULSE ON TIME Control setting.
Excessive burn-through on reverse side of weld.	Welding voltage set too high.	Repeat Steps 5a thru f in Section 6-2 to reset voltage and wire feed speed parameters.
No dark blue circle or small protrusion on reverse side of weld, but when welded pieces are pulled apart, a small hole is torn in bottom piece of metal.	Voltage and wire feed speed parameters set correctly, but spot time too short.	Increase SPOT TIME/PULSE ON TIME Control setting.
No dark blue circle or small protrusion on reverse side of weld, and when welded pieces are pulled apart, there is minimal penetration into lower piece of metal.	Welding voltage set too low.	Repeat Steps 5a thru f in Section 6-2 to reset voltage and wire feed speed parameters.

## SECTION 7 – MAINTENANCE & TROUBLESHOOTING

### 7-1. ROUTINE MAINTENANCE

**IMPORTANT:** *Every six months inspect the labels on this unit for legibility. All precautionary labels must be maintained in a clearly readable state and replaced when necessary. See Parts List for part number of precautionary labels.*



**WARNING: ELECTRIC SHOCK can kill.**

- Do not touch live electrical parts.
- Shut down welding power source, and disconnect input power employing lockout/tagging procedures before inspecting, maintaining, or servicing.

Lockout/tagging procedures consist of removing input power plug from receptacle, padlocking line disconnect switch in open position, removing fuses from fuse box, or shutting off and red-tagging circuit breaker or other disconnecting device.

**MOVING PARTS can cause serious injury.**

- Keep away from moving parts.

**HOT SURFACES can cause severe burns.**

- Allow cooling period before servicing.
- Do not depress gun trigger while performing maintenance on gun.

Maintenance to be performed only by qualified persons.

**Table 7-1. Maintenance Schedule**

Frequency*	Maintenance
Every month.	Units in heavy service environments: Check labels, weld cables, clean internal parts and drive rolls.
Every 6 months.	Check all labels (see IMPORTANT block, Section 7-1). Inspect gun and cables (Section 7-1C). Clean drive rolls (Section 7-1D).

\*Frequency of service is based on units operated 40 hours per week. Increase frequency of maintenance if usage exceeds 40 hours per week.

#### A. Fan Motor

This unit is equipped with an exhaust fan and relies on forced draft for adequate cooling. The fan motor requires no maintenance other than periodic cleaning according to Section 7-1B.

#### B. Internal Cleaning



**WARNING: Read and follow safety information at beginning of entire Section 7-1 before proceeding.**

Every six months, blow out or vacuum dust and dirt from the inside of the welding power source. Remove the outer enclosure, and use a clean, dry airstream or vacuum suction for the cleaning operation. If dusty or dirty conditions are present, clean the unit monthly.

#### C. Inspection and Upkeep



**WARNING: Read and follow safety information at beginning of entire Section 7-1 before proceeding.**

Every six months, inspect the gun, hoses, and cables. If dusty or dirty conditions are present, inspect the unit monthly. Inspection should consist of the following:

1. Open side access door.
2. Inspect gun for broken areas, cracks, and loose parts; tighten, repair, and replace as required.
3. Repair or replace, as required, all hose and cable; give particular attention to frayed and cracked insulation and areas where hose and cables enter equipment.
4. Remove grease and grime from components, moisture from electrical parts and cable.



**CAUTION: FLYING DIRT AND METAL CHIPS can injure personnel and damage equipment.**

- Point gun liner only in a safe direction away from personnel and equipment when cleaning with compressed air.

5. Blow out the gun wire guide liner with compressed air when changing wire. This will remove any metal chips and dirt that may have accumulated.
6. Close and secure side access door.

#### D. Cleaning Of Drive Rolls



**WARNING: Read and follow safety information at beginning of entire Section 7-1 before proceeding.**

**MOVING PARTS can cause serious injury.**

- Keep away from moving parts.

**HIGH ROTATIONAL SPEED can cause damage to drive rolls and injure personnel.**

- Do not allow drive rolls to rotate at high speed if compressed air is used for cleaning the drive roll assembly.

It is necessary to remove the drive rolls for proper cleaning of the wire grooves (see Section 7-2 for removal and installation instructions). Use a wire brush to clean rolls.

**IMPORTANT: Failure to properly maintain the drive rolls can result in a buildup of wire particles which decreases the efficiency of the wire feeding operation.**



## 7-2. REPLACING DRIVE ROLL AND WIRE INLET GUIDE (Figure 7-1)

As a result of wear or a change in wire size, it may be necessary to replace the drive rolls and wire inlet guide. Proceed as follows:



**WARNING: ELECTRIC SHOCK can kill.**

- Do not touch live electrical parts.
- Shut down welding power source, and disconnect input power employing lockout/tagging procedures before inspecting, maintaining, or servicing.

Lockout/tagging procedures consist of removing input power plug from receptacle, padlocking line disconnect switch in open position, removing fuses from fuse box, or shutting off and red-tagging circuit breaker or other disconnecting device.

### A. Replacing Upper Drive Roll



**WARNING: Read and follow safety information at beginning of entire Section 7-2 before proceeding.**

1. Disassembly
  - a. Open and secure left side access door.

- b. Release pressure spring from spring pin on drive roll cover.
- c. Remove cotter pin from drive roll cover pivot pin.
- d. Remove pivot pin, thereby freeing drive roll cover from drive assembly.
- e. Remove retaining ring and flanged bearing from one end of drive roll shaft.
- f. Push drive roll shaft out drive roll cover until drive roll falls from cover. Be sure that key remains in slot in drive roll shaft.

### 2. Assembly

- a. Install drive roll into drive roll cover with gear section of drive roll facing the rear of the cover (side facing motor insulator). Be sure to align clearance hole in drive roll with the two shaft clearance holes in drive roll cover.
- b. Align key in drive roll shaft with keyway in drive roll, and route end of drive roll shaft without retaining ring and bearing through hole in rear side of drive roll cover, through drive roll, and out front side of cover.
- c. Reinstall flanged bearing and retaining ring removed in Step 1e onto end of drive roll shaft.

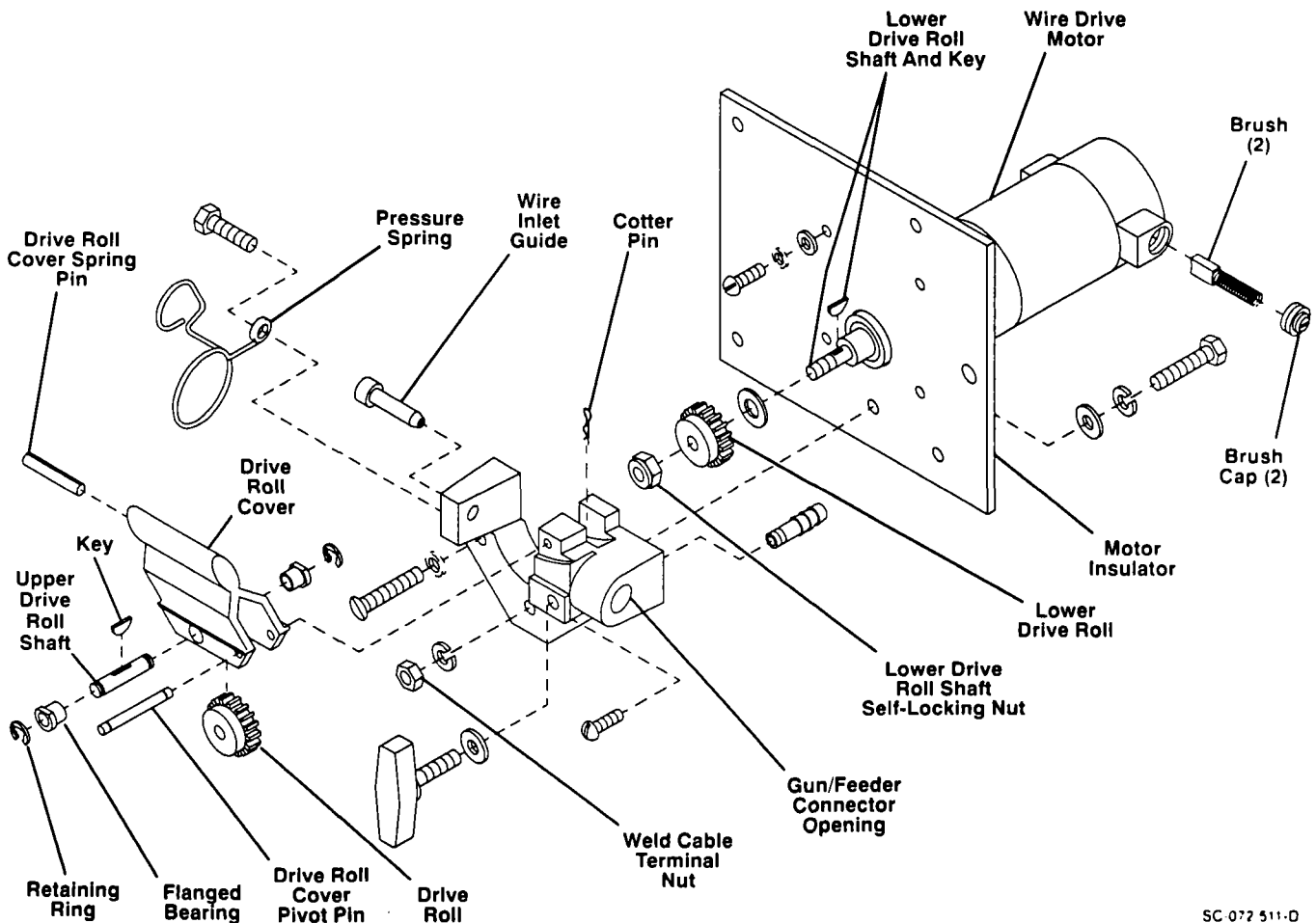


Figure 7-1. Replacing Drive Rolls And Motor Brushes

SC 072 511-D

- d. Reinstall drive roll cover and pivot pin into drive roll assembly.
- e. Reinstall cotter pin onto pivot pin.
- f. If installing or changing lower drive roll, proceed to Section 7-2B; otherwise, reengage pressure spring over spring pin on drive roll cover, and close and secure access door.

## B. Replacing Lower Drive Roll



**WARNING:** Read and follow safety information at beginning of entire Section 7-2 before proceeding.

1. Disassembly
  - a. If applicable, release pressure spring from spring pin on drive roll cover.
  - b. If applicable, pivot upper drive roll up, away from lower drive roll.
  - c. Remove self-locking nut from end of lower drive roll shaft, and remove drive roll. Be sure that key remains in slot in drive roll shaft.
2. Assembly
  - a. Install drive roll onto lower drive roll shaft aligning keyway in drive roll clearance hole with key in drive roll shaft. (Drive roll must be installed with gear section facing the motor insulator.)
  - b. Reinstall self-locking nut onto drive roll shaft.
  - c. Adjust horizontal position of lower drive roll in or out as necessary. To move the drive roll in towards the motor insulator, rotate the self-locking nut clockwise. To move the drive roll out away from the center panel of the unit, rotate the nut counterclockwise.

**IMPORTANT:** Be sure that upper and lower drive roll gears are properly meshed and the drive roll grooves are aligned when adjusting horizontal position of lower drive roll.

- d. Reengage pressure spring over spring pin on drive roll cover.
- e. If replacing wire inlet guide, proceed to Section 7-2C; otherwise, close and secure side access door.

## C. Replacing Wire Inlet Guide

1. Loosen wire guide securing screw.
2. Remove wire guide from drive housing.
3. Install new wire guide through mounting hole in left side of drive housing (see Figure 7-1).

**IMPORTANT:** Wire guide should be installed as close to the drive rolls as possible without touching them.

4. Tighten wire guide securing setscrew.

5. Close and secure side access door.

## 7-3. DRIVE HOUSING REALIGNMENT (Figure 4-7)



**WARNING: ELECTRIC SHOCK can kill.**

- Do not touch live electrical parts.
- Shut down welding power source, and disconnect input power employing lockout/tagging procedures before inspecting, maintaining, or servicing.

Lockout/tagging procedures consist of removing input power plug from receptacle, padlocking line disconnect switch in open position, removing fuses from fuse box, or shutting off and red-tagging circuit breaker or other disconnecting device.

The wire drive housing is made with mounting holes of sufficient clearance to provide adjustment of the wire guides up or down in relation to the drive rolls. This adjustment has been factory set, but if readjustment becomes necessary proceed as follows:

1. Open access door.
2. Loosen mounting bolts and the weld terminal nut, securing wire drive housing to the air baffle.
3. Slide drive housing upward or downward until the wire can be fed straight through the guides while seated in the drive roll.
4. Tighten mounting bolts and weld terminal nut.
5. Close and secure access door.

## 7-4. REPLACING HUB ASSEMBLY (Figure 7-2)

If it should become necessary to replace part or all of the hub assembly, reinstall the new hub assembly as follows:

1. Slide the following items onto the single support shaft in order given:
  - a. Fiber Washer
  - b. Brake Washer
  - c. Hub
  - d. Brake Washer
  - e. Fiber Washer
  - f. Keyed Washer
  - g. Spring
  - h. Flat Washer
2. Rotate hex nut onto support shaft. Hex nut should be rotated only until a slight drag is felt while turning hub.
3. Install welding wire according to Section 4-13.
4. Reinstall retaining ring onto hub.

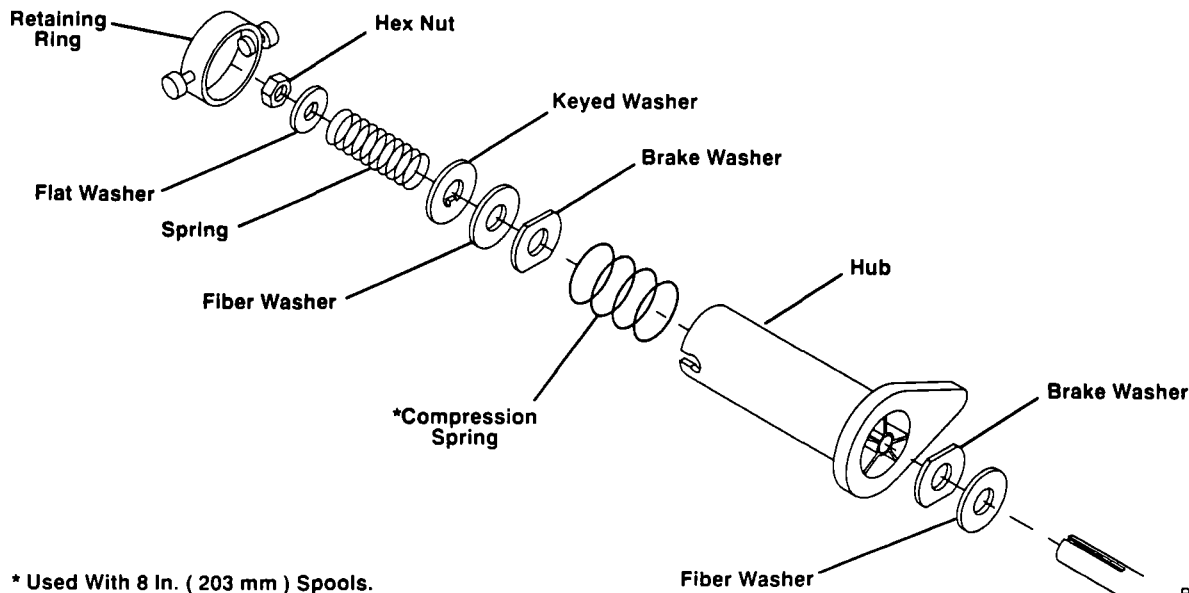


Figure 7-2. Hub Assembly

7-5. INSPECTING AND REPLACING MOTOR BRUSHES (Figure 7-1)



**WARNING: ELECTRIC SHOCK can kill.**

- Do not touch live electrical parts.
- Shut down welding power source, and disconnect input power employing lockout/tagging procedures before inspecting, maintaining, or servicing.

Lockout/tagging procedures consist of removing input power plug from receptacle, padlocking line disconnect switch in open position, removing fuses from fuse box, or shutting off and red-tagging circuit breaker or other disconnecting device.

1. Open access door.
2. Remove the brush caps (two).
3. Remove brushes.
4. Examine brushes. Replace brushes if they are chipped or broken or if less than 1/4 in. (6 mm) of brush material remains.
5. Install brushes, and secure with caps.



**CAUTION: DISASSEMBLY OF THE MOTOR FIELD MAGNETS can result in personal injury and equipment damage.**

- Limit drive motor repairs to brush replacement.

The field magnets are very strong. If disassembly is attempted, injury to fingers and hands may result from the rotor being drawn back into the motor. The field magnets are matched sets, and operation may be affected if the magnets are tampered with. Warranty is void if the motor is tampered with.

6. Close and secure access door.

7-6. OVERLOAD PROTECTION



**WARNING: ELECTRIC SHOCK can kill.**

- Do not touch live electrical parts.
- Shut down welding power source, and disconnect input power employing lockout/tagging procedures before inspecting, maintaining, or servicing.

Lockout/tagging procedures consist of removing input power plug from receptacle, padlocking line disconnect switch in open position, removing fuses from fuse box, or shutting off and red-tagging circuit breaker or other disconnecting device.

A. Circuit Breaker CB1



**WARNING: Read and follow safety information at beginning of entire Section 7-6 before proceeding.**

The drive motor is protected from damage due to overload by circuit breaker CB1, located under the access door. Should an overload on CB1 occur, the contactor W coil would open thereby stopping all output from the welding power source.

If CB1 opens, manually reset the circuit breaker as follows:

1. Open access door.
2. Check for jammed wire or clogged gun liner, and correct problem. If motor overload occurs repeatedly, repair or replace the motor or liner.
3. Check for binding drive gear or misaligned drive rolls, and correct problem.
4. Reset circuit breaker CB1 (depress button); it may be necessary to allow a cooling period before the breaker can be reset.
5. Close and secure access door.
6. Resume operation.

## B. Circuit Breaker CB2



**WARNING:** Read and follow safety information at beginning of entire Section 7-6 before proceeding.

Circuit breaker CB2 protects the 24 volts ac winding of transformer T1 from overload. CB2 is located under the access door. Should CB2 open, the contactor W coil would open thereby stopping all output from the welding power source. If CB2 opens, manually reset the breaker.

### 7-7. THERMAL OVERLOAD PROTECTION

Rectifier SR1 is protected from overheating by a normally-closed thermostat TP3 wired in series with relay CR1 and contactor W coil circuit. Should overheating occur, TP3 would open causing CR1 and thereby the contactor to drop out (deenergize) and the wire drive motor to stop, thereby stopping all weld output. If this condition occurs, it will be necessary to allow a cooling period before resuming operation.

### 7-8. PRINTED CIRCUIT BOARD REPLACEMENT



**WARNING:** ELECTRIC SHOCK can kill.

- Do not touch live electrical parts.
- Shut down welding power source, and disconnect input power employing lockout/tagging procedures before inspecting, maintaining, or servicing.

Lockout/tagging procedures consist of removing input power plug from receptacle, padlocking line disconnect switch in open position, removing fuses from fuse box, or shutting off and red-tagging circuit breaker or other disconnecting device.



**CAUTION:** ELECTROSTATIC DISCHARGE (ESD) can damage circuit boards.

- Put on properly grounded wrist strap BEFORE handling circuit boards.
- Transport circuit boards in proper static-shielding carriers or packages.
- Perform work only at a static-safe work area.

**INCORRECT INSTALLATION** or misaligned plugs can damage circuit board.

- Be sure that plugs are properly installed and aligned.

**EXCESSIVE PRESSURE** can break circuit board.

- Use only minimal pressure and gentle movement when disconnecting or connecting board plugs and removing or installing board.

## 7-9. TROUBLESHOOTING



**WARNING:** ELECTRIC SHOCK can kill.

- Do not touch live electrical parts.
- Shut down welding power source, and disconnect input power employing lockout/tagging procedures before inspecting, maintaining, or servicing.

Lockout/tagging procedures consist of removing input power plug from receptacle, padlocking line disconnect switch in open position, removing fuses from fuse box, or shutting off and red-tagging circuit breaker or other disconnecting device.

**MOVING PARTS** can cause serious injury.

- Keep away from moving parts.

**HOT SURFACES** can cause severe burns.

- Allow cooling period before servicing.

Troubleshooting to be performed only by qualified persons.

It is assumed that the unit was properly installed according to Section 4 of this manual, the operator is familiar with the function of controls, the welding power source was working properly, and that the trouble is not related to the welding process.

The following table is designed to diagnose and provide remedies for some of the troubles that may develop in this welding power source. Use this table in conjunction with the circuit diagram while performing troubleshooting procedures. If the trouble is not remedied after performing these procedures, contact the nearest Factory Authorized Service Station. In all cases of equipment malfunction, strictly follow the manufacturer's procedures and instructions.

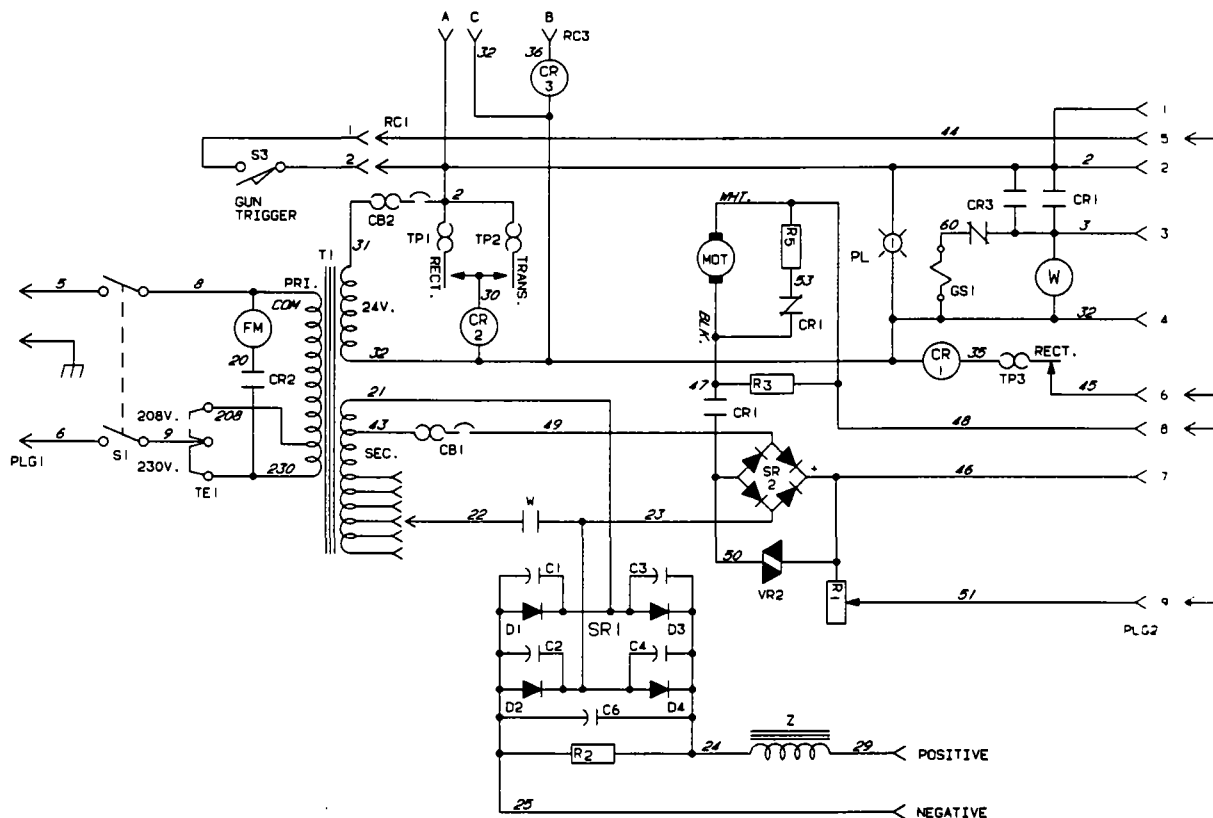
Table 7-2. Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
No weld output; wire does not feed.	Line Disconnect Switch in OFF position.	Place Line Disconnect Switch in ON position.
	Improper electrical input connections.	See Section 4-12 for proper input connections.
	Input voltage jumper links not in proper position.	See Section 4-12 for proper jumper link position.
	Line fuse(s) open.	Check and replace open line fuses.
	Main rectifier SR1 overheating (thermal shutdown).	Allow rectifier to cool down (see Section 7-7).
	Gun switch, or gun switch leads.	See gun Owner's Manual.
	POWER switch S1.	Replace S1.
	Switch control relay CR1.	Replace CR1.
No weld output; wire feeds.	THICKNESS VOLTS plug not secure in receptacle.	Secure connection.
	Work clamp connection loose or incomplete due to rust, paint, etc. on surface of workpiece.	Check work connection for good metal-to-metal contact.
	Contact tube.	See gun Owner's Manual.
Low weld output.	Low input voltage.	Check for proper input voltage.
	Input voltage jumper link in wrong position.	See Section 4-12 for proper jumper link position.
Electrode wire stops feeding while welding.	Circuit breaker CB2.	Check and reset CB2 if necessary (see Section 7-6).
	Sharp or excessive bend in gun cables or liners.	Straighten gun cables and/or replace liners (see gun Owner's Manual).
	Incorrect hub tension.	Readjust hub tension (see Section 4-11).
	Contact tube opening restricted; burnback of wire into tube.	See gun Owner's Manual.
	Friction in gun.	See gun Owner's Manual.
	Gun liner dirty, restricted.	See gun Owner's Manual.
	Broken or damaged gun liner.	See gun Owner's Manual.
	Worn drive rolls.	Replace drive rolls (see Section 7-2).
	Drive rolls misaligned.	Realign drive rolls (see Sections 7-2 and 7-3).
	Excessive loading of drive motor.	Clear restriction in drive assembly.
	Drive motor brushes.	Check and replace brushes if necessary (see Section 7-5).
	Drive Motor M.	Check and replace motor if necessary.
Gun trigger switch inoperative or leads broken.	See gun Owner's Manual.	
Unit shuts down while welding.	Fan motor FM.	Check and replace FM if necessary.

Table 7-2. Troubleshooting (Continued)

TROUBLE	PROBABLE CAUSE	REMEDY
No open-circuit voltage.	THICKNESS VOLTS plug not secure in receptacle.	Secure plug in receptacle.
	Contactors W points.	Contact nearest Factory Authorized Service Station.
	Gun switch.	See gun Owner's Manual.
	Transformer T1.	Contact nearest Factory Authorized Service Station.
	Plug PLG2 not secure in receptacle RC55 (models with optional Spot Weld Panel only).	Secure PLG2 into RC55.
Wire does not feed; open circuit voltage normal.	Circuit breaker CB1 or CB2.	Reset CB1 or CB2 (see Section 7-6).
	Rectifier SR2.	Contact nearest Factory Authorized Service Station.
	Wire feed motor M.	Replace M.
Spot weld timer does not time out (models with SPW-1 panel).	SPW-1 panel or circuit board PC50.	See Section 7-8, and contact nearest Factory Authorized Service Station.
Pulsed wire feed operation not available.	SPW-1 panel or circuit board PC50.	See Section 7-8, and contact nearest Factory Authorized Service Station.

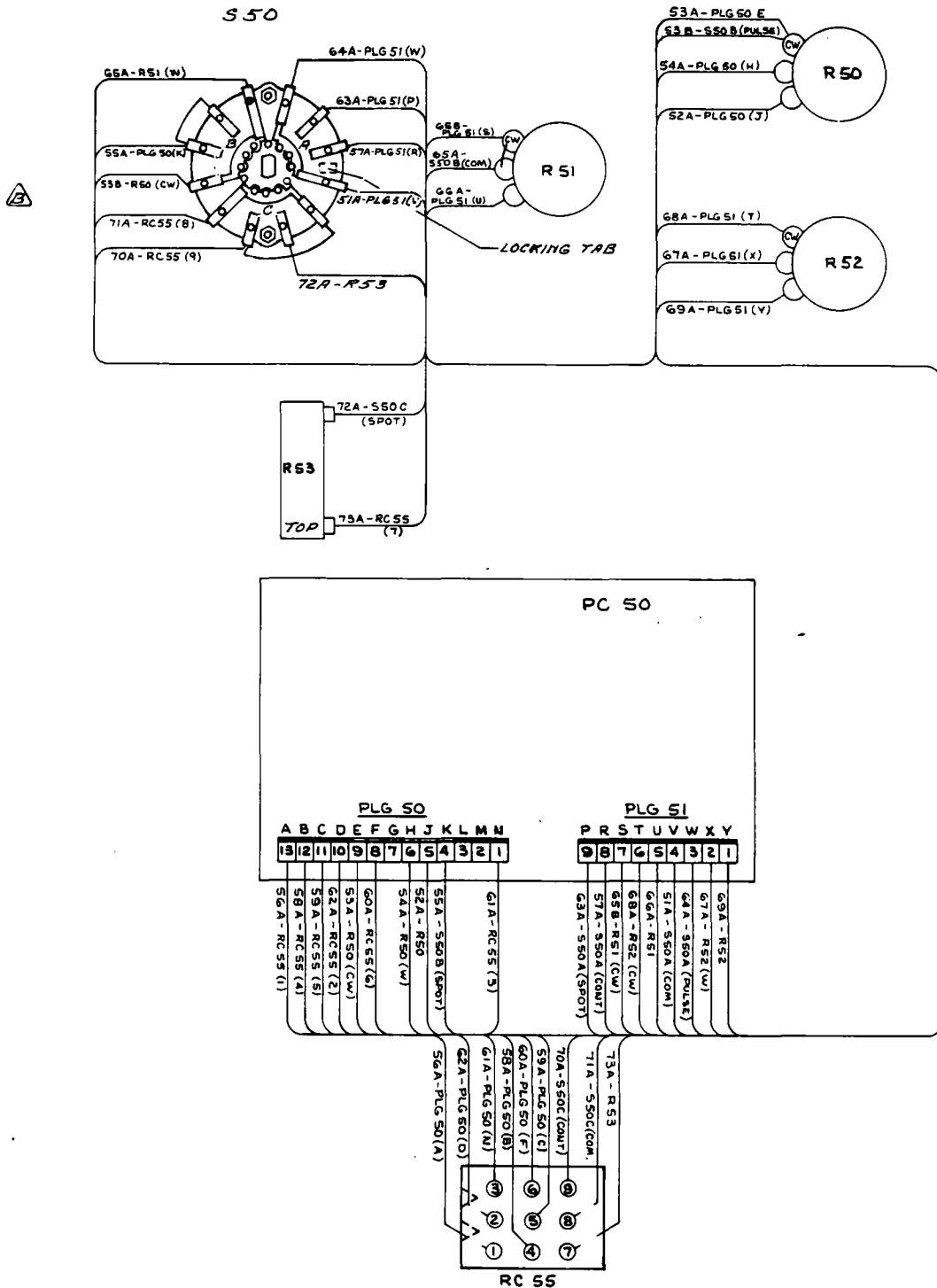
## SECTION 8 – ELECTRICAL DIAGRAMS



Circuit Diagram No. SB-121 827

Diagram 8-1. Circuit Diagram For MW 4150 Models

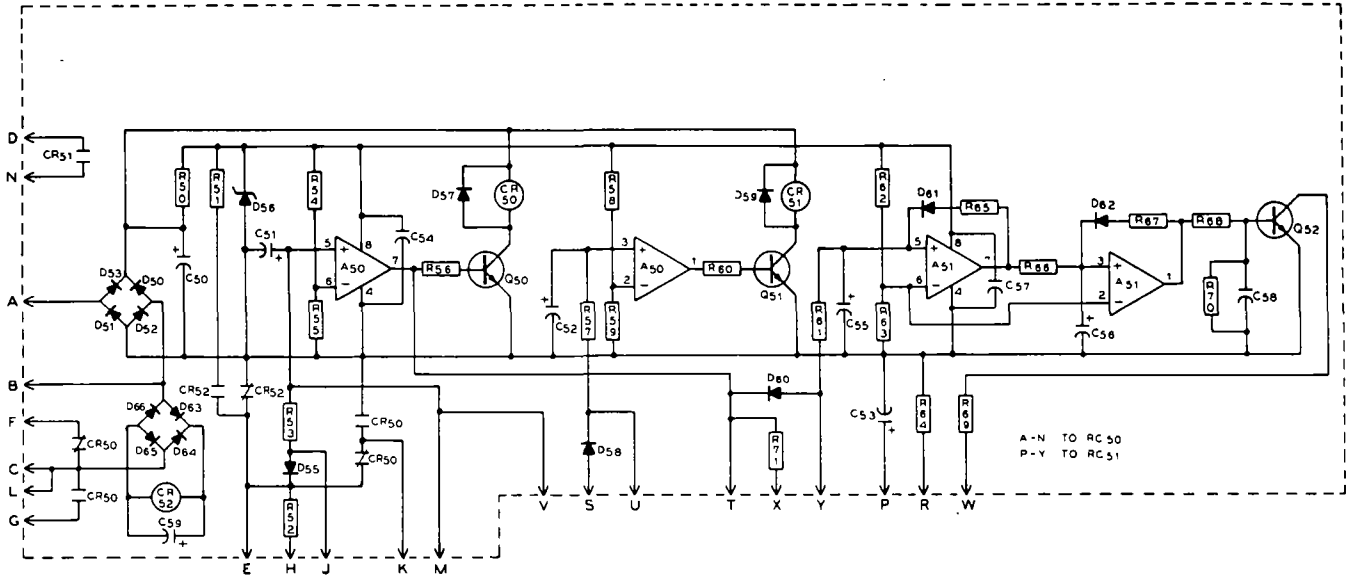




Wiring Diagram No. C-090 711-B

Diagram 8-4. Wiring Diagram For SPW-1 Panel





Circuit Diagram No. B-092 817-A

Diagram 8-5. Circuit Diagram For SPW-1 Panel Dual Timer/Pulser Board PC50

## SECTION 9 – WELDING TECHNIQUES & TROUBLESHOOTING



**CAUTION: WELDING CURRENT** can damage vehicle components and other electronic components.

- *Disconnect both battery cables before welding on a vehicle.*
- *Place work clamp as close to the weld as possible to avoid long electrical paths.*
- *Be sure gun to power source as well as cable connections to work clamp are clean and tight.*
- *To be 100 percent free of risk, disconnect the computer(s) from the vehicle.*

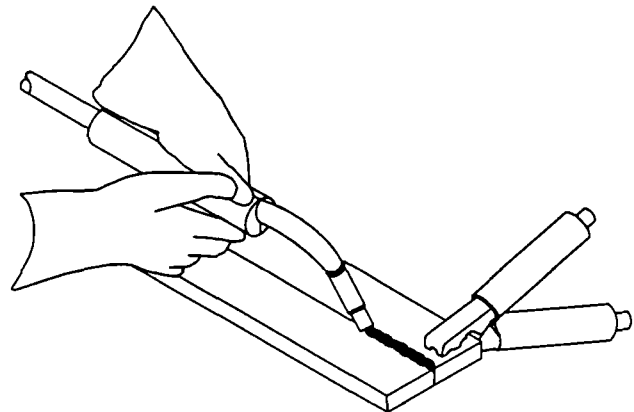
### 9-1. GAS METAL ARC WELDING (GMAW) – CONTINUOUS SEAM



Figure 9-1. Continuous Seam

The ability to produce a good bead while using the Continuous Seam Gas Metal Arc process is dependent on several factors. One of the most important, after wire and shielding gas selection, is the way the gun is held. Cradle the gun in one hand and rest the side of the hand on the workpiece (avoid doing this on hot material); use other hand to hold gun and control the gun trigger. Position the gun either toward or away from the body at a 45 to 60 degree lead angle (see Figure 9-2). This will give a good view of the arc and make it easier to follow the seam while wearing a helmet. Maintain a 1/4 to 5/16 inch (6-8 mm) distance from the bottom of the gun nozzle to the workpiece during the arc starting and welding period. Do not pull the gun back from the seam when the arc starts, as this will create a long wire extension and result in a poor weld.

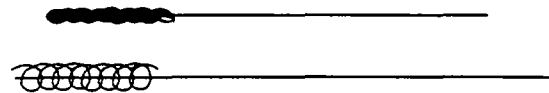
The welding wire is not energized until the trigger is pressed. Therefore the welding wire can be extended 1/4 inch (6 mm) beyond the gun nozzle and placed on the seam before lowering the helmet and pressing the gun trigger.



S-0421

Figure 9-2. Gun Position

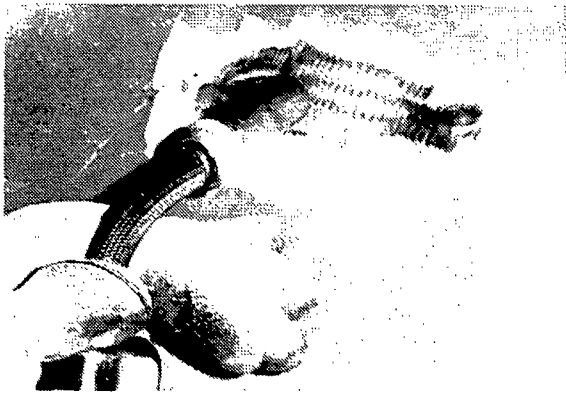
The gun can be moved along the seam in a steady movement known as the drag technique (see Figure 9-3), or it can be oscillated a few degrees beyond each side of the seam. The travel speed will be regulated by the type of weld bead required, the thickness of the material, welding current selected and the technique used. However, the average speed is 15 to 20 inches per minute (0.4-0.5 mpm).



S-0422

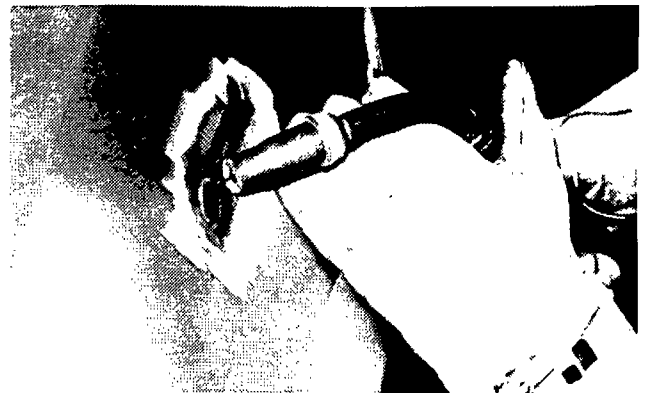
Figure 9-3. Welding Techniques

Other welding techniques that affect the weld characteristics in the GMAW welding process include the backhand and forehand technique, and the vertical up and vertical down positions. In the backhand technique the gun is positioned so that the electrode wire is feeding in the opposite direction of arc travel. The filler metal is being fed into the weld metal previously deposited. In the forehand technique the gun is angled so that the electrode wire is fed in the same direction as the arc travel. The backhand technique generally yields a more stable arc and less spatter on the workpiece.



Direction of Arc Travel →

**Backhand Technique**



← Direction of Arc Travel

**Forehand Technique**

**Figure 9-4. Longitudinal Gun Positions**

The vertical up and/or vertical down techniques describe the direction of arc travel when the welding must be done in the vertical position. In both of these techniques gun positioning is extremely important because the arc must be kept on the leading edge of the puddle to ensure com-

plete weld penetration. The drag technique is generally employed when welding in the vertical position, but when bridging a gap, the arc can be oscillated from one side of the work to the other.



**Vertical Up**



**Vertical Down**

**Figure 9-5. Welding In The Vertical Up And Vertical Down Position**

**9-2. GAS METAL ARC WELDING (GMAW)-PULSED**



**Figure 9-6. Pulsed Seam**

In pulsed welding the filler metal is transferred to the work during the period of Pulse On Time, and cools during the period of Pulse Off Time. When the selector switch is placed in the PULSE position and the gun trigger is depressed, the welding wire feeds through the gun

for the length of time set on the SPOT TIME/PULSE ON TIME control. At the end of the pulse on time the welding wire stops feeding for the length of time set on the PULSE OFF TIME control. This on and off sequence continues for the amount of time selected on the time control until the gun trigger is released. The pulse option provides better control of the heat input to the weld on thin gauge metals, thereby decreasing distortion and the likelihood of burn throughs.

Set-up procedures for pulsed seam welding are the same as those for continuous seam welding except that the SELECTOR SWITCH is placed in the PULSE position and the SPOT TIME/PULSE ON TIME control and PULSE OFF TIME controls must be set to the desired positions.

### 9-3. GAS METAL ARC WELDING (GMAW)-SPOT

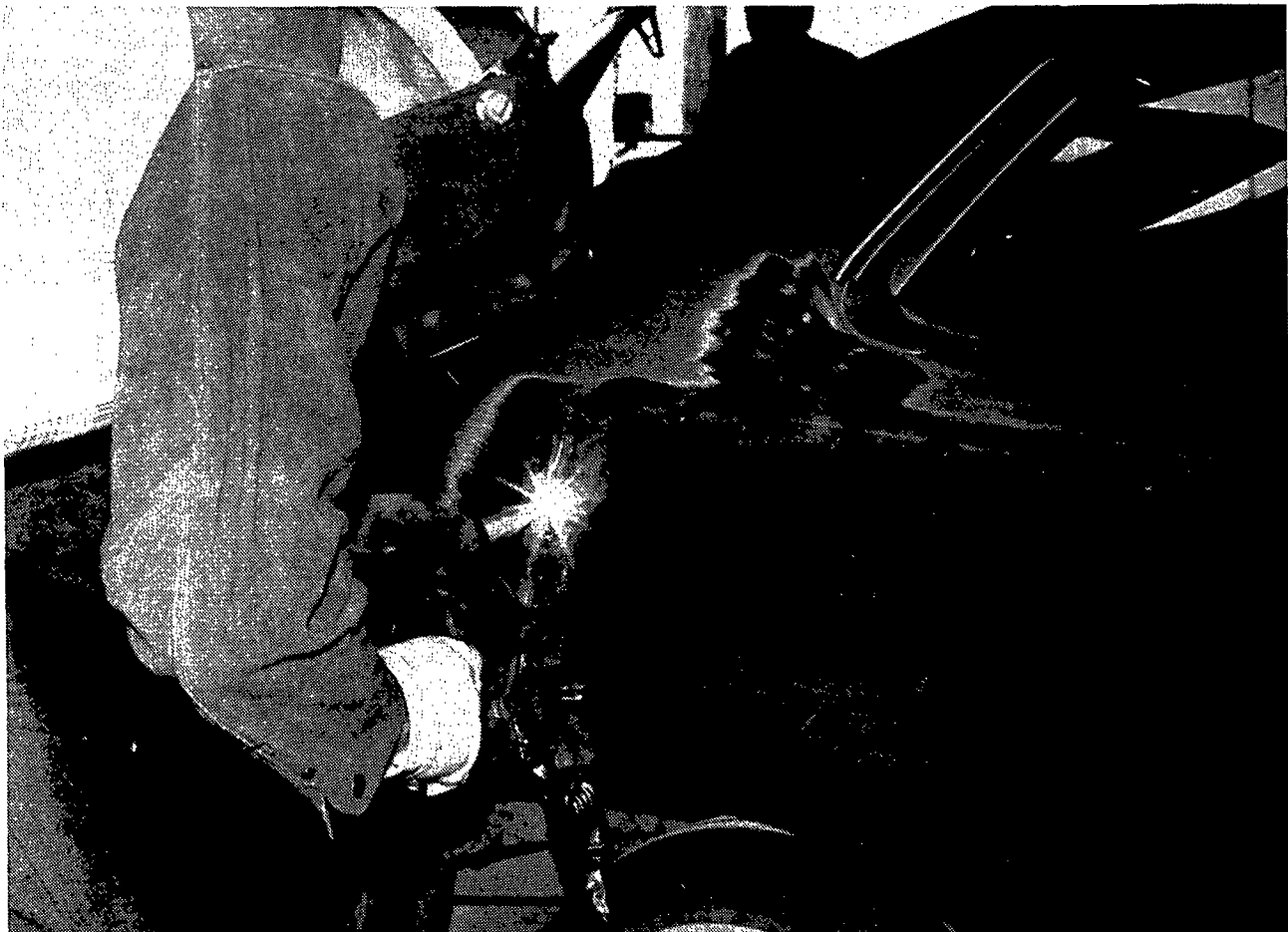


**Figure 9-7. Spot Weld**

Instead of having a continuous or pulsed weld to join two pieces of sheet steel together, welding in spot of 1 to 1-1/2 inches (25-38 mm) apart can be done. The MIG spot welding process fuses two pieces of sheet steel together by penetrating entirely through one of the pieces into the other. The spot process is designed to be used in any position. Little joint preparation is required other than cleaning the surfaces and ensuring that the two pieces overlap.

Spot welding is based on the same principles as continuous seam welding except that there is no travel speed involved; instead, there is a welding time interval. The weld is made by placing the welding gun directly on the top sheet and holding it motionless as shown in Figure 9-8. When the gun trigger is depressed, the electrode wire and shielding gas will be continuously fed. The arc will be maintained for the full length of time set on the SPOT TIME/PULSE ON TIME control and it will continue to penetrate in one place until the top sheet is welded with the bottom sheet. After the preset welding time has elapsed the wire will stop feeding, the contactor will open and the arc will be broken.

The GMAW spot welding process produces little heat, therefore little distortion results. Because of the low heat characteristics of this technique, it is often used when welds are made in close proximity to upholstery, rubber, or other flammable materials.



**Figure 9-8. Fender Repair With Spot Nozzle**

#### 9-4. PLUG WELDS

Plug welds provide a means of joining two pieces of metal where the thickness of the top sheet is beyond the normal range of the welding power source or where sheet metal sections are too thin to be spot welded or pulsed welded without producing distortion or burn throughs. The plug weld is made by drilling or punching a hole in the top sheet, clamping the metal sections tightly together, and filling the hole with a weldment. The plug weld can be timed using the spot timer or untimed. Plug welds should be spaced 1 to 1-1/2 inches (25-38 mm) apart.

Plug welds on sample materials should be made so that proper parameters can be set.

#### 9-5. SKIP WELDING

Skip welding provides a means of making a series of short welds, usually less than 3/4 in., (18 mm) in length each, consistent in size and appearance. Skip welding can be accomplished with this unit by setting a spot weld time and jogging the gun trigger off and on again each time the spot timer times out.

Skip welds on sample material should be made so that proper parameters can be set.

#### 9-6. TROUBLESHOOTING THE GAS METAL ARC WELDING PROCESS

##### A. Porosity



Figure 9-9. Porosity

Possible Causes	Corrective Actions
1. Inadequate shielding gas coverage.	Remove spatter from the gun nozzle.
	Check gas hoses for leaks.
	Eliminate drafts (from fans, open doors, etc.) blowing into the welding arc.
	Place nozzle 1/4 to 5/16 in. (6-8 mm) from workpiece.
	Increase gas flow to displace all air from the weld zone.
	Decrease excessive gas flow to avoid turbulence and the entrapment of air in the weld zone.
	Hold gun at end of weld until molten metal solidifies.
	Check for frozen CO <sub>2</sub> regulator/flowmeter.
2. Wrong gas.	Use welding grade shielding gas.
3. Dirty welding wire.	Use clean and dry welding wire.
	Eliminate pick up of oil or lubricant on welding wire from feeder or conduit.
4. Workpiece dirty.	Remove all grease, oil, moisture, rust, paint, undercoating, and dirt from work surface before welding.
	Use a more highly deoxidizing welding wire.
5. Welding wire extends too far out of nozzle.	Welding wire should extend 1/4 in. (6 mm) out of nozzle.

**B. Excessive Spatter**

Possible Causes	Corrective Actions
1. Excessive spatter when using CO <sub>2</sub> shielding gas.	Select lower voltage range or adjust FINE TUNING WIRE SPEED control.

**C. Incomplete Fusion (Lack of fusion)**



**Figure 9-10. Incomplete Fusion**

Possible Causes	Corrective Actions
1. Workpiece dirty.	Clean weld surfaces of impurities (grease, oil, moisture, rust, paint, dirt, etc.) prior to welding.
2. Insufficient heat input.	Select higher voltage range or adjust FINE TUNING WIRE SPEED control.
3. Improper welding technique.	When using a weaving technique dwell momentarily on the side walls of the groove.
	Provide improved access at root of joints.
	Keep electrode directed at the leading edge of the puddle.
	Provide proper gun angle.

**D. Lack of Fusion**



**Figure 9-11. Lack of Penetration**

Possible Causes	Corrective Actions
1. Improper joint preparation.	Material too thick. Joint preparation and design must be adequate to provide access to the bottom of the groove while maintaining proper welding wire extension and arc characteristics.
2. Improper weld technique.	Maintain normal gun angle to achieve maximum penetration (see Section 9-1).
	Keep arc on leading edge of the puddle.
3. Insufficient heat input.	Select higher voltage range and wire speed.
	Reduce the travel speed.
	Be sure welding wire extends 1/4 in. (6 mm) out of nozzle.

**E. Excessive Penetration (Burn-Through)**



**Figure 9-12. Excessive Penetration**

Possible Causes	Corrective Actions
1. Excessive heat input.	Select lower voltage range and reduce wire speed.
	Increase travel speed.

**F. Cracks in Weld Metal**

Possible Causes	Corrective Actions
1. Improper joint preparation.	Material too thick. Joint preparation and design must be adequate to provide access to the bottom of the groove while maintaining proper welding wire extension and arc characteristics.
2. Heat input too high causing excessive shrinkage and distortion.	Select lower voltage range and reduce wire speed.
	Increase travel speed.

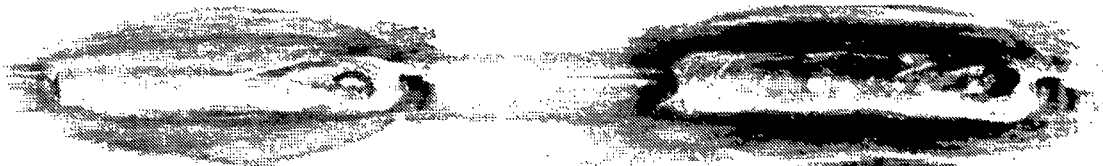
**G. Waviness of Bead**



**Figure 9-13. Waviness of Bead**

Possible Causes	Corrective Actions
1. Welding wire extends too far out of nozzle.	Welding wire should extend 1/4 in. (6 mm) out of nozzle.
2. Unsteady hand.	Support hand on solid surface.

**H. Humping**



**Figure 9-14. Humping**

Possible Causes	Corrective Actions
1. Excessive heat input.	Select lower voltage range or increase travel speed.
	Weld in small segments and allow to cool between welds.

## SECTION 10 – AUTO BODY REPAIR APPLICATION



**CAUTION: WELDING CURRENT** can damage vehicle computers and other electronic components.

- *Disconnect both battery cables before welding on a vehicle.*
- *Place work clamp as close to the weld as possible to avoid long electrical paths.*
- *Be sure gun to power source as well as cable connections to work clamp are clean and tight.*
- *To minimize risk, disconnect the computer(s) from the vehicle.*

### 10-1. POINTERS FOR WELDING AUTO BODY SHEET METAL

Before using this equipment to weld on a finished piece of work, make a few practice welds on a sample piece of material the same as that of the finished workpiece. Whenever possible, weld in the flat position since this is the easiest position to learn. Be sure that the material to be welded is clean and free of paint and rust. The work cable clamp must be attached to the parts being welded. Clean surface to ensure proper grounding and to complete the current path.

Use a .030 or .023 in. (0.8 or 0.6 mm) E70S-6 wire and argon/carbon dioxide shielding gas.

Use direct current straight polarity for reduced burn through. To obtain straight polarity (electrode wire to negative-work lead to positive), place the Negative/Positive weld output selector plug in the NEGATIVE WELD OUTPUT RECEPTACLE and connect the work (ground) lead to the POSITIVE WELD OUTPUT RECEPTACLE.

**IMPORTANT:** *For maximum penetration on thicker materials such as 18 gauge (1.22 mm) and thicker, reconnect for direct current reverse polarity (work lead to negative, electrode wire to positive).*

### 10-2. PROCEDURE FOR WELDING MILD STEELS

The following are some basic guidelines that can be used when using this welding power source to weld mild or high strength steels:

1. Use a power wire brush or sander to remove paint to bare metal in the area to be repaired. Two to three inches (51-76 mm) on either side of the weld area should be cleaned for applying body filler after welding is completed.
2. Remove damaged metal using hand cutters, shears, or a power hand grinder equipped with a cutting wheel.
3. Fit a new piece of sheet steel over the section which was removed. The new material should overlap the cut away section by one inch (25 mm).

4. Clamp the new metal in place, and prepare to spot weld.
5. Rotate the FINE TUNING WIRE SPEED control to 50%, the weld timer at 30 to 40 percent, the burnback at 40 to 50 percent and the selector switch to the SPOT position.
6. Install the spot nozzle on the gun.
7. With the shielding gas and power source turned on, place the spot nozzle and press firmly against the new material about 1/2 to 3/4 in. (12-18 mm), from the edge. Fit up must be tight to assure good, repeatable spot welds.
8. Begin spot welding from the center out on each side. Distortion may occur if welding begins at the corners.
9. Space spot welds 1 to 1/2 in. (25-38 mm) apart around repair. Spot welds should be about 3/16 in. (5 mm) in diameter.

**IMPORTANT:** *Do not make continuous welds around the repair as this will promote distortion and warpage.*

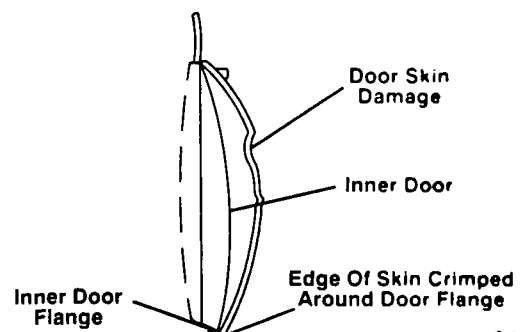
10. After welding, remove the clamp and grind spot flush to surface.
11. Smooth the joints with body filler and finish.

### 10-3. PROCEDURES FOR WELDING DOOR PANELS

**IMPORTANT:** *Every experienced autobody repairman will have his own method of performing the following procedures. However, this information is presented to show how, in most cases, this welding power source can make the job easier and less time consuming.*

If the door is severely damaged, but the damage is primarily in the outer panel, or "skin", the door can be easily repaired without necessarily installing a whole new door.

1. Remove exterior molding and hardware. It is not necessary to remove window regulator, remote control mechanisms, lock or runs.
2. Remove door assembly, and place on flat surface with edges of door extending over edges of surface to provide room to work.



S-0418

**Figure 10-1. Cutaway Of Door Panel Damage**



SECTION 11 – PARTS LIST

Ref. SD-072 507-L

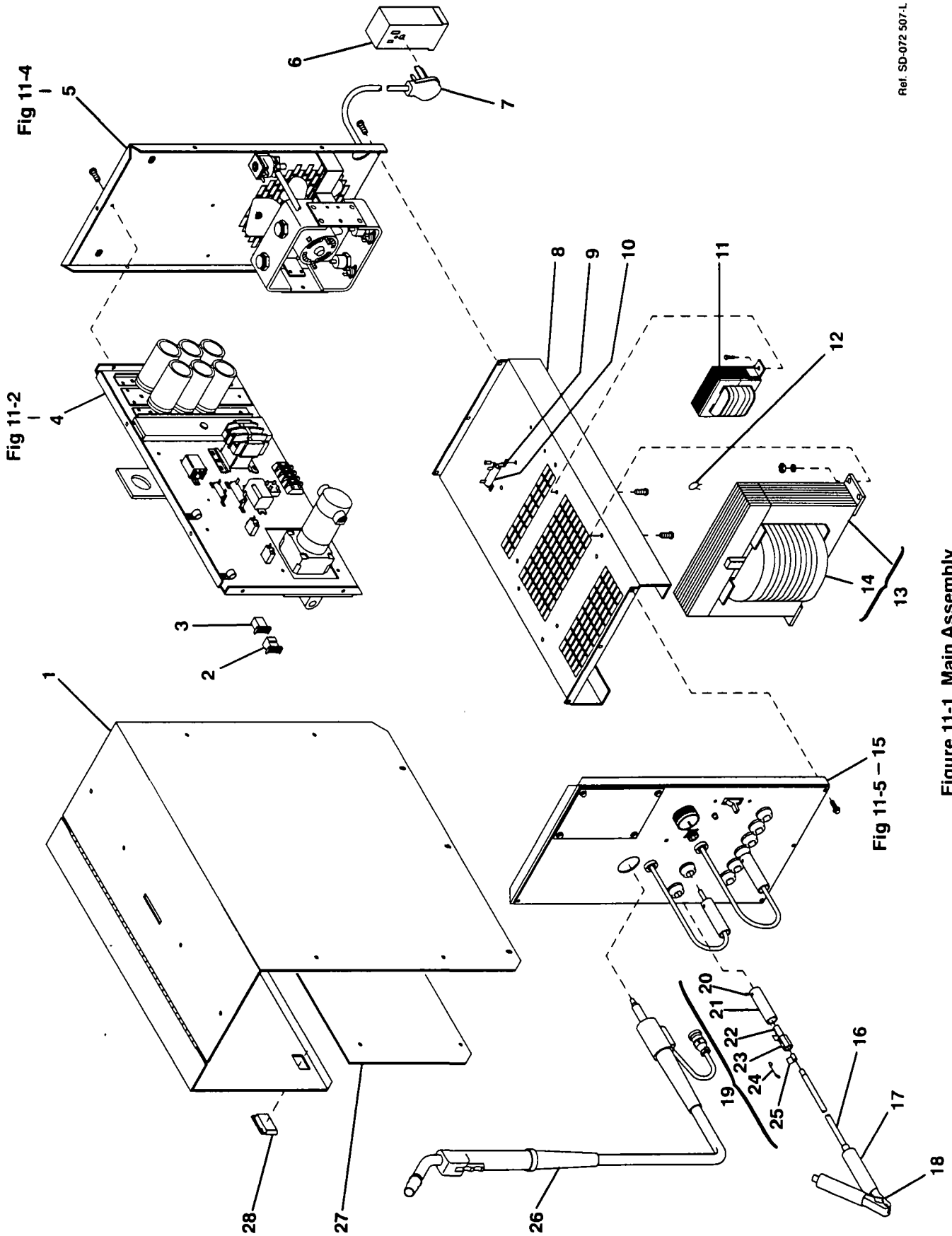
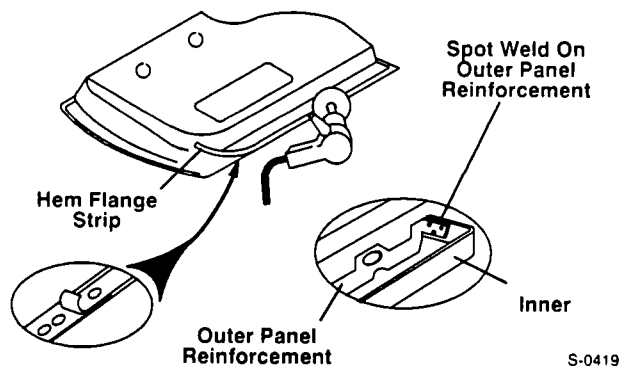


Figure 11-1. Main Assembly

3. If door has an outer panel reinforcement, break the weld.
4. Grind off the hem flange and remove the old panel.
5. Repair any damage to the inner panel.
6. Position the new outer panel over door and bend the end flange over the inner flange.
7. Spot weld outer panel reinforcement to new door panel.
8. Spot weld new hem flange to inner panel.
9. Metal finish exterior surface, paint and assembly interior trim and hardware.



**Figure 10-2. Hem Flange Removal**

#### 10-4. HOW TO PREVENT GLASS BREAKAGE AND SPATTER ON WINDOWS

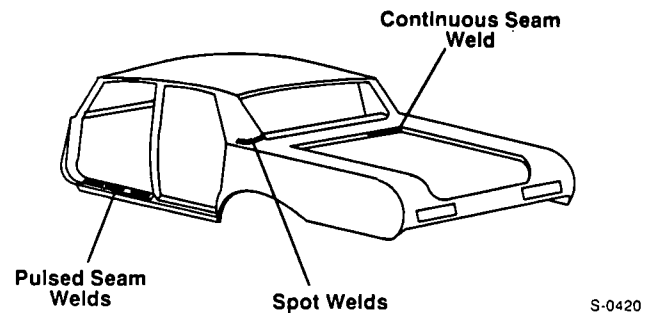
Spatter and excessive heat can become problems when welding near windows. Protect the windows by keeping them covered and as far away from the heat zone as possible. When welding must be performed near windows, the windows should be covered and protected from excessive heat by using wet rags. A putty like substance which reduces heat transfer is available through your welding supplier. If burn through and spatter become problems, ensure that the correct voltage tap is being used for the size material being welded. Use an argon and CO<sub>2</sub> gas mixture and check travel speed.

#### 10-5. PROCEDURES FOR WELDING FENDERS AND QUARTER PANELS

When a complete panel must be replaced it will be necessary to remove the bolts securing the panel to the rest of the structure, or to cut through the spot welds if the panel is welded in place. In most cases a front fender will be bolted in place, while the other panels will be either spot welded or continuous seam welded. The alignment of front fenders is usually simple because the bolt holes are often elongated so that the position of the new front fender can be shifted and correctly aligned. Generally all other panels are welded into place.

If the whole panel is to be replaced, the old panel must be removed by cutting along the weld if welded by continuous seam, or by drilling out the spot welds if it is spot welded in place. Car and body manufacturers have the

panels welded in different places, so it will be necessary to inspect the body to determine where the welds are located in each case. After the old panel is removed, the inner panels must be carefully checked, straightened or replaced.



**Figure 10-3. Automotive Body Sections Assembled With Continuous Seam, Pulsed, And Spot Welds**

The new outer panel can then be placed and held in position by vice-grips or c-clamp. When welding, start at the center and proceed first in one direction and then the other. In order to ensure reduced distortion due to heat, weld only a section of 2 or 3 in. (51-76 mm) at a time. It is important to constantly check the over all temperature of the sheet steel around the welding area, because it is in this concentrated heat area that warpage and distortion will begin. Leave a gap and then weld another short section. When the weld is completed it can be hammered down, filled with body putty and sanded.

#### 10-6. WELDING FRAMES AND HIGH STRENGTH (HSS) STEELS

The new HSS steels are used on many of the new economy compact cars. HSS steels can be found in the steel gussets, brackets, floor pans, and support members of these new models. HSS steels are thinner for weight reduction and are heat sensitive. As heat is applied, the strength decreases and cracking can occur, therefore the heat affected zone must be kept as small as possible. For this reason the MIG welding process has become the preferred method for welding HSS steels, and the oxyacetylene welding or brazing processes, with its wider heat affective area, are normally not recommended.



**Figure 10-4. Application Of Body Putty**

Item No.	Dia. Mkgs.	Part No.	Description	Quantity	
				Model	
				MW 4150	MW 4200
<b>Figure 11-1. Main Assembly</b>					
1		115 521	WRAPPER .....	1	1
2		008 072	HOUSING PLUG & PINS, (consisting of) .....	1	1
		058 791	· TERMINAL, male 1 pin .....	8	8
3	PLG2	008 073	HOUSING RECEPTACLES & SOCKETS, (consisting of) .....	1	1
		058 972	· TERMINAL, female 1skt .....	8	8
4		Fig 11-2	BAFFLE, air w/components .....	1	1
5		Fig 11-4	PANEL, rear w/components .....	1	1
6		039 778	RECEPTACLE, str 2P3W 50A 250V .....	1	1
7	PLG1	023 210	CABLE SET, pwr 250V 10ga 3/c 9ft .....	1	1
8		083 175	SKID, base .....	2	2
9		605 741	CLIP, mtg resistor .312 ID core .....	2	2
10	R2	079 781	RESISTOR, WW fxd 25W 50 ohm .....	1	1
11	Z	083 912	STABILIZER .....	1	1
12	TP2	089 276	THERMOSTAT, NO .....	1	1
13	T1	093 173	TRANSFORMER, power main (200(208)/230) (consisting of) ....	1	1
		092 028	· COIL, pri/sec .....	1	1
15		Fig 11-5	PANEL, front w/components .....	1	1
16		023 100	CABLE, interconnecting grd .....	1	1
17		026 843	INSULATOR, vinyl blk-43 .....	2	
18		010 368	CLAMP, grd 200A .....	1	
18		130 750	CLAMP, grd 350A .....		1
19		039 901	PLUG, jack blk (consisting of) .....	1	1
20		602 160	· SCREW, sltptg type F filh 8-32 x .250 .....	1	1
21		026 978	· INSULATOR, jack plug blk .....	1	1
22		101 219	· PLUG, jack 5/8 x 2-5/8 .....	1	1
23		602 178	· SCREW, set stl sch .250-20 x .375 knr cup point .....	2	2
24		010 521	· WIRE, tie bag 16ga x 5 in .....	1	1
25		019 833	· STRIP, cop .010 x 2.500 x .750 .....	1	1
		602 171	· WRENCH, hex .125 .....	1	1
26		++	MWG-160 GUN .....	1	
26		++	MWG-200 GUN .....		1
27		115 522	PANEL, side .....	1	1
		122 679	LABEL, instruction .....	1	
		135 358	LABEL, instruction .....		1
28		089 899	LATCH, slide flush style .....	2	2
		Fig 11-8	RUNNING GEAR .....	1	1
		113 280	HOSE, air 4ft (consisting of) .....	1	1
		089 120	· CLAMP, hose .375-.450 .....	4	4
		113 129	· TUBING, PVC .250 ID x .062 wall (order by ft) .....	4ft	4ft
		112 863	· FITTING, adapter hose kit .....	1	1
		112 811	LABEL, Auto Arc emblem (rear panel) .....	1	1
		113 603	LABEL, Auto Arc MW-4150 (top of front panel) .....	1	
		113 605	LABEL, Auto Arc MW-4150 (left side panel) .....	1	
		113 606	LABEL, Auto Arc MW-4150 (right side panel) .....	1	
		134 874	LABEL, Auto Arc MW-4200 (top of front panel) .....		1
		134 875	LABEL, Auto Arc MW-4200 (left side panel) .....		1
		134 876	LABEL, Auto Arc MW-4200 (right side panel) .....		1
		120 714	LINER, monocoil .030-.035 wire (consisting of) .....		1
		120 715	· COLLET, liner .035 wire .....		1
		087 299	TUBE, cont scr .023 wire x 1.125 .....		2
		000 067	TUBE, cont scr .030 wire x 1.125 .....		2
		000 068	TUBE, cont scr .035 wire x 1.125 .....		2
		087 332	ADAPTER, tube contact .....		1

++For Parts List of MWG-160 GUN See Form No. 112 934 And For MWG-200 GUN See Form No. 113 337.  
BE SURE TO PROVIDE MODEL AND SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS.

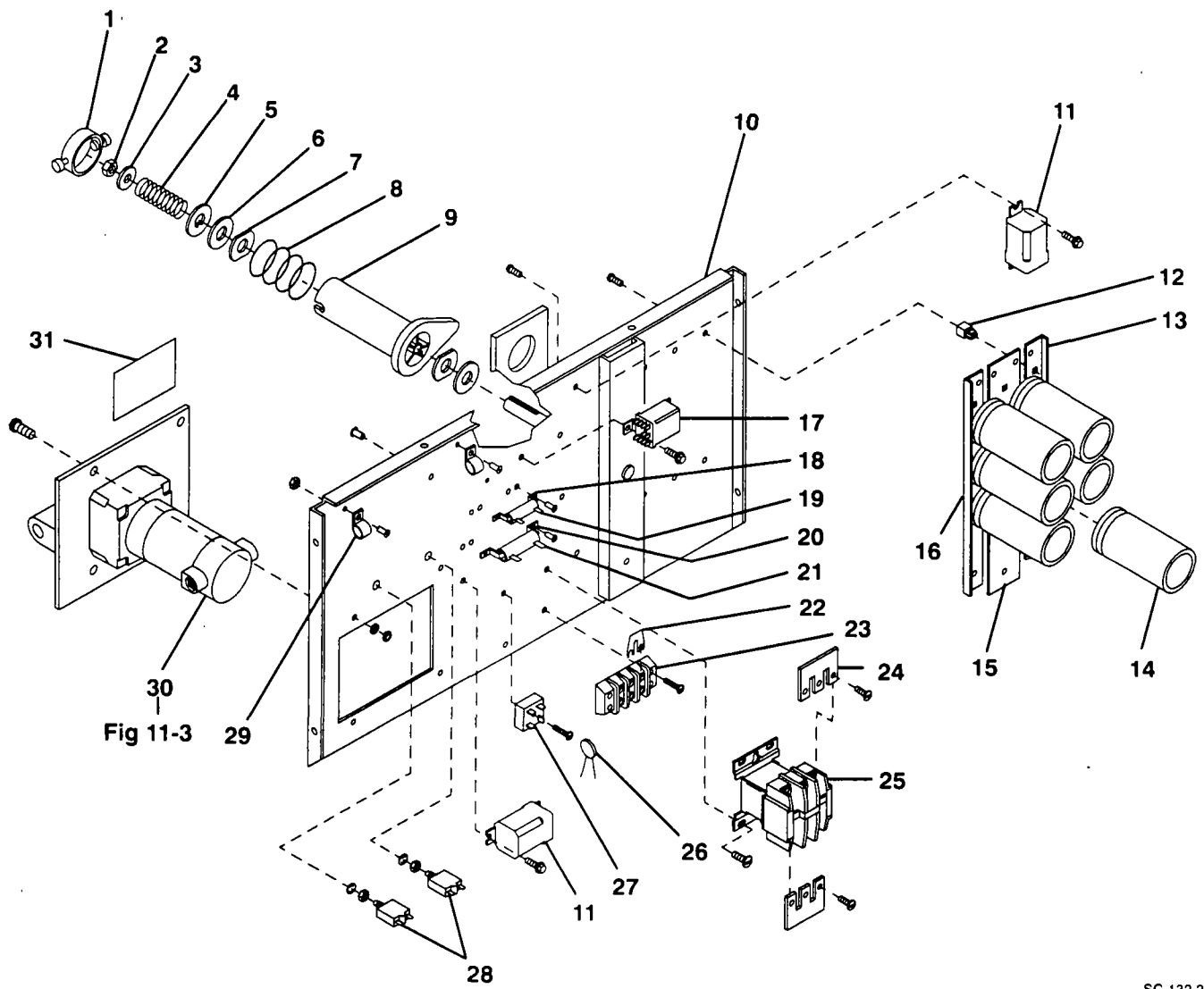


Fig 11-3

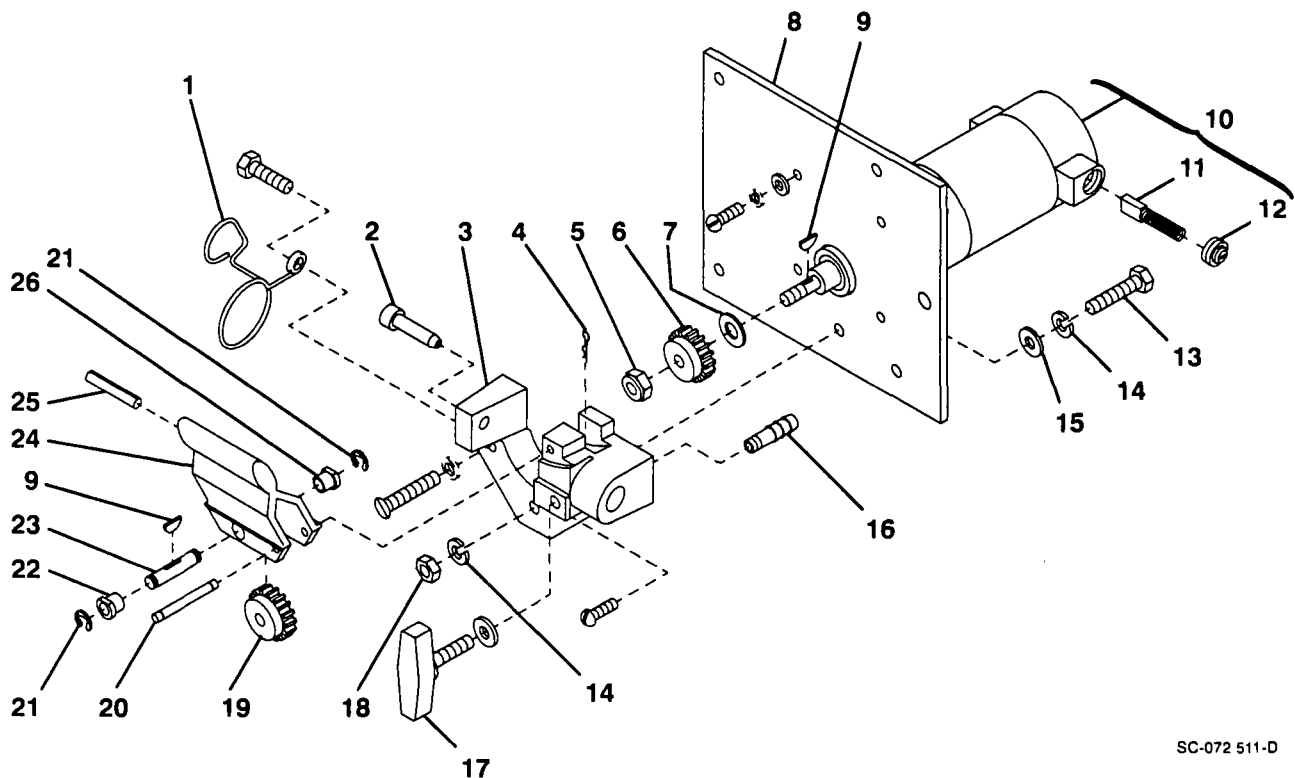
Figure 11-2. Baffle, Air w/Components

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Item No.	Dia. Mkgs.	Part No.	Description	Quantity
<b>Figure 11-2. Baffle, Air w/Components (Fig 11-1 Item 4)</b>				
1		058 427	RING, retaining spool	1
2		085 980	NUT, stl hex full fnsh .625-11	1
3		605 941	WASHER, flat stl .640 ID x 1.000 OD x 14ga thk	1
4		057 543	SPRING, cprsn .845 OD x .091 wire x 1.500	1
5		057 971	WASHER, flat stl keyed 1.500 dia x .125thk	1
6		010 191	WASHER, fbr .656 ID x 1.500 OD x .125thk	2
7		058 628	WASHER, brake stl	2
8		057 745	SPRING, cprsn 2.430 OD x .090 wire x 2.500	1
9		058 428	HUB, spool	1
		026 837	INSULATOR, term nylon	1
10		044 995	BAFFLE, air	1
11	CR2,3	006 393	RELAY, encl 24VAC DPDT	2
12		083 147	GROMMET, scr No. 8/10 panel hole .312sq .500 high	6
13		082 907	ANGLE, mtg RH capacitor	1
14	C6	031 728	CAPACITOR, elcltlt 20000uf 35VDC	6
15		082 902	STRIP, mtg center capacitor	1
16		082 875	ANGLE, mtg LH capacitor	1
17	CR1	072 817	RELAY, encl 24VAC DPDT	1
18		052 704	CLIP, spring mtg resistor	2
19	R5	006 537	RESISTOR, WW fxd 12W .51 ohm	1
20		605 741	CLIP, mtg resistor .312 ID core	2
21	R3	059 642	RESISTOR, WW fxd 25W 10 ohm	1
22		038 620	LINK, jumper term blk 30A	1
23	TE1	026 189	BLOCK, term 30A 3P	1
24		034 260	LINK, connecting contactor terminal	2
25	W	035 519	CONTACTOR, def prp 40A 3P 24V (consisting of)	1
		024 493	COIL, cntor 24VAC 40A	1
26	VR2	046 685	VARISTOR, .6W 175VDC	1
27	SR2	035 704	RECTIFIER, integ 40A 800V	1
28	CB1,2	083 431	CIRCUIT BREAKERS, man reset 1P 5A 250V	2
29		010 145	CLAMP, nylon .500 clamp dia	2
30		122 192	DRIVE ASSEMBLY, wire (Fig 11-3)	1
31		031 773	LABEL, important whenever the upper	1

BE SURE TO PROVIDE MODEL AND SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS.

Item No.	Dia. Mkgs.	Part No.	Description	Quantity
<b>122 192 Figure 11-3. Drive Assembly, Wire (Fig 11-2 Item 30)</b>				
1		057 551	SPRING, pressure drive roll	1
2		058 549	GUIDE, wire inlet 1/16	1
2		087 331	GUIDE, wire outlet .025	1
3		120 370	HOUSING, drive roll feeder	1
4		604 741	PIN, cotter hair .042 x .937	1
5		605 525	NUT, stl siflkg hex thin .312-24	1
6		057 590	GEAR, drive roll V groove .030-.035 wire keyed (top)	1
7		010 929	WASHER, flat stl spr .375	1
8		044 994	INSULATOR, motor	1
9		605 287	KEY, woodruff .062 x .250	2
10	M	119 040	MOTOR, gear PM 12V 1/25hp 3550RPM (consisting of)	1
11		130 820	BRUSH & SPRING	2
12		057 432	SCREW, cap holder brush	2
13		079 624	SCREW, cap stl hex hd siflkg .375-16 x 2.250	1
14		602 213	WASHER, lock stl split .375	2
15		010 910	WASHER, flat stl SAE .375	1
16		079 633	FITTING, hose brs barbed nipple 3/16tbg	1
17		079 772	KNOB, plstc T 1.500 lg x .312-18 x 2.000 bar	1
18		601 838	NUT, brs hex .375-16 jam hvy	1
19		058 553	GEAR, drive roll no groove .024 wire keyed (bottom)	1
20		058 359	PIN, pivot	1
21		605 854	RING, retaining	2
22		072 649	BEARING, drive assy wire	1
23		058 360	SHAFT, drive roll	1
24		058 363	COVER, drive roll	1
25		010 918	PIN, spring CS .156 x 1.500	1
26		072 585	BEARING, drive assy wire	1



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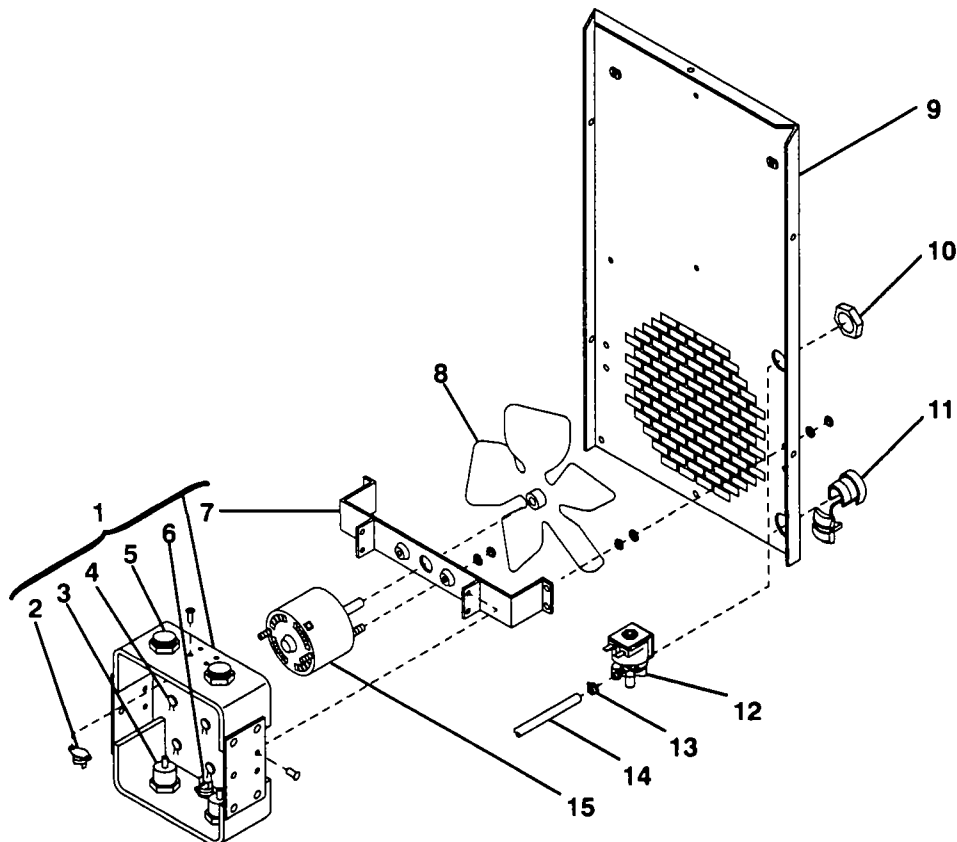
**Figure 11-3. Drive Assembly, Wire**

**BE SURE TO PROVIDE MODEL AND SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS.**

Item No.	Dia. Mkgs.	Part No.	Description	Quantity	
				Model	
				MW 4150	MW 4200

**Figure 11-4. Panel, Rear w/Components (Fig 11-1 Item 5)**

1	SR1	137 914	RECTIFIER/WINDTUNNEL, si diode (consisting of)	1	
1	SR1	137 913	RECTIFIER/WINDTUNNEL, si diode (consisting of)		1
2	TP1	604 515	THERMOSTAT, NC	1	
2	TP2	006 334	THERMOSTAT, NC		1
3	D3,4	037 306	DIODE, rect 150A 300V RP	2	
3	D7,9	037 957	DIODE, rect 275A 300V RP		2
		605 886	WASHER, lock stl intl tooth .750		4
		605 884	NUT, stl hex half .750-16		4
4	C1-4	031 689	CAPACITOR, rectifier	4	
4	C14-17	031 689	CAPACITOR, rectifier		4
5	D1,2	037 305	DIODE, rect 150A 300V SP	2	
5	D6,8	037 956	DIODE, rect 275A 300V SP		2
6	TP3	086 323	THERMOSTAT, NO	1	1
7		137 912	BRACKET, mtg fan motor	1	1
8		032 662	BLADE, fan 10in 5wg	1	1
9		134 982	PANEL, rear	1	1
10		605 227	NUT, nyl hex jam .750	1	1
11		010 290	BUSHING, strain relief 1.030 ID	1	1
12	GS1	125 785	VALVE, 24VAC 2 way custom port 1/8 orf	1	1
13		089 120	CLAMP, hose .375-.450	1	1
14		604 550	HOSE, nprn brd No.1 x .187 ID (order by ft)	3ft	3ft
15	FM	032 678	MOTOR, 1/50hp 230VAC 1500RPM	1	1



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**Figure 11-4. Panel, Rear w/Components**

**BE SURE TO PROVIDE MODEL AND SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS.**

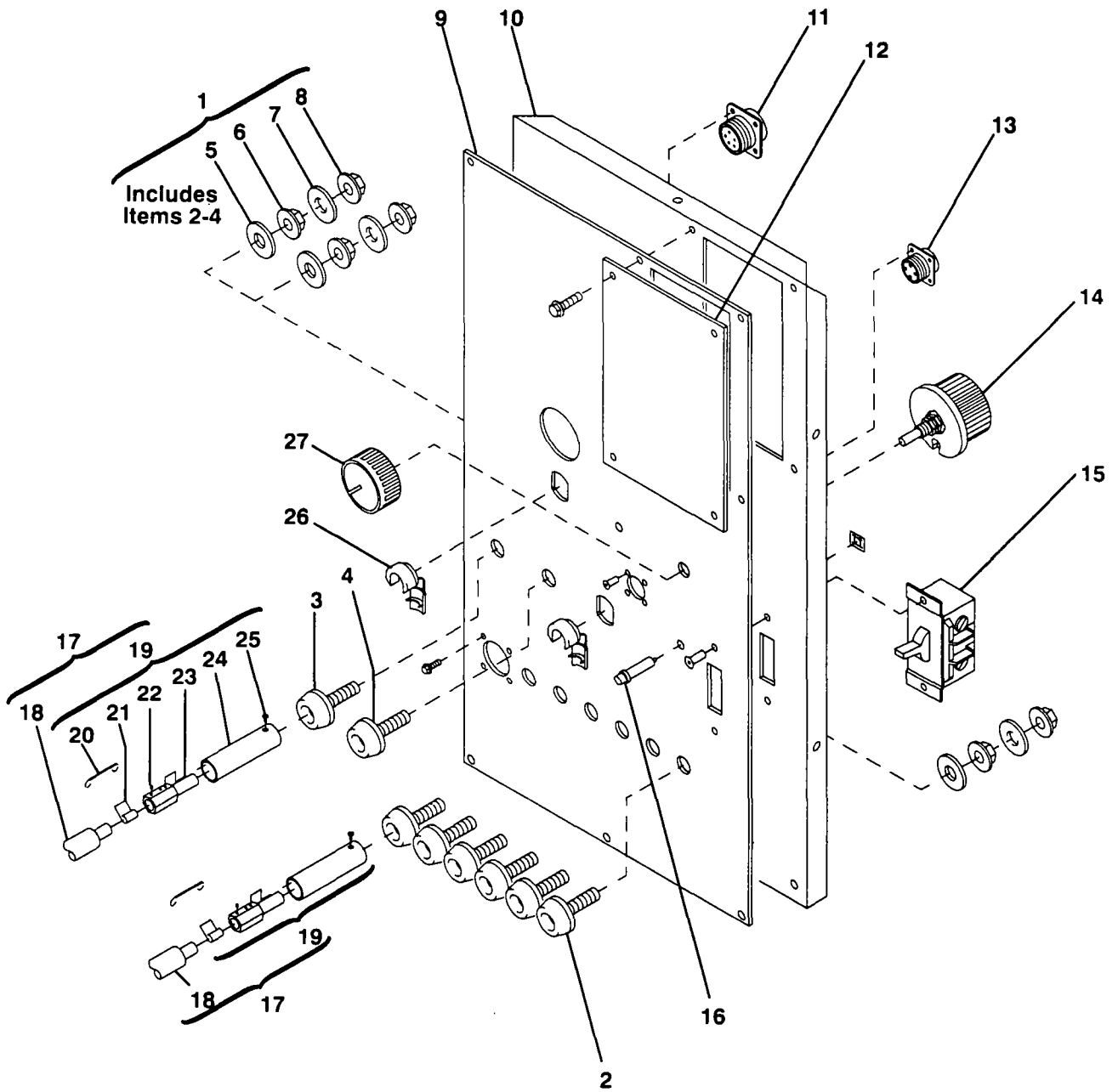


Figure 11-5. Panel, Front w/Components

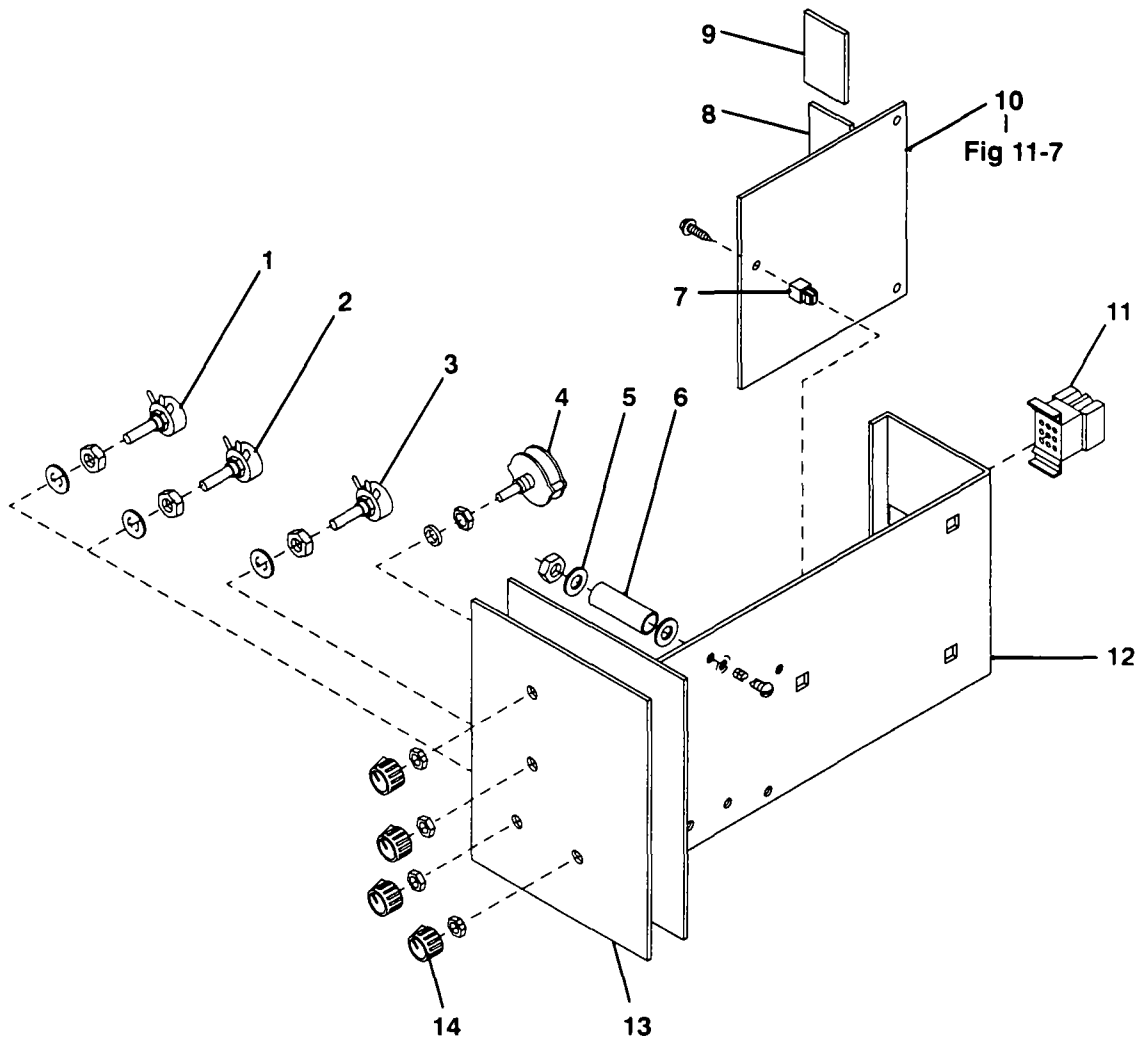
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Item No.	Dia. Mkgs.	Part No.	Description	Quantity
<b>Figure 11-5. Panel, Front w/Components (Fig 11-1 Item 15)</b>				
1		039 801	RECEPTACLE, jack plug blk (consisting of)	1
1		039 800	RECEPTACLE, jack plug red (consisting of)	1
1		057 608	RECEPTACLE, jack plug yellow (consisting of)	6
2		072 334	· RECEPTACLE & NUT, jack plug yellow	1
3		091 542	· RECEPTACLE & NUT, jack plug blk	1
4		091 541	· RECEPTACLE & NUT, jack plug red	1
5		010 291	· WASHER, flat nylafil .625 ID x 1.250 OD x .125thk	1
6		604 668	· NUT, stl slfkg hex med fnsh .500-20	1
7		605 787	· WASHER, lock stl intl tooth .500	1
8		601 881	· NUT, stl hex jam .500-20	1
9		+119 543	NAMEPLATE, (order by model and serial number)	1
		113 604	LABEL, Auto Arc warning	1
10		119 191	PANEL, front	1
11	RC3	073 383	RECEPTACLE, 3 skt MS-3102A-14S-1S	1
		052 236	PLUG, 3 pin MS-3106A-14S-1P Amphenol	
12		113 742	COVER, Auto Arc open module	1
13	RC1	048 282	RECEPTACLE W/SOCKET, (consisting of)	1
		079 534	· TERMINAL, female 1skt 18-14 wire	4
14	R1	605 828	RHEOSTAT, WW 50W 1.5 ohm	1
15	S1	124 511	SWITCH, tgl DPST 40A 600VAC	1
16	PL1	048 573	LIGHT, ind red lens 28V	1
17		023 084	CABLE & PLUG, jack (consisting of)	1
17		044 943	CABLE & PLUG, jack (consisting of)	1
18		600 318	· CABLE, weld cop strd No. 3 (order by ft)	As Req'd
19		039 878	· PLUG, jack yellow (consisting of)	1
19		039 608	· PLUG, jack red (consisting of)	1
20		010 521	· WIRE, tie bag 16ga x 5 in	1
21		019 833	· STRIP, cop .010 x 2.500 x .750	1
22		602 178	· SCREW, set stl sch .250-20 x .375 knr cup point	2
23		101 219	· PLUG, jack 5/8 x 2-5/8	1
24		026 975	· INSULATOR, jack plug (yellow)	1
24		602 814	· INSULATOR, jack plug (red)	1
25		602 160	· SCREW, sltpg filh 8-32 x .250	1
26		010 325	BUSHING, strain relief .840 ID x .875mtg hole	2
27		097 824	KNOB, pointer	1

+When ordering a component originally displaying a precautionary label, the label should also be ordered.  
**BE SURE TO PROVIDE MODEL AND SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS.**

Item No.	Dia. Mkgs.	Part No.	Description	Quantity
<b>Figure 11-6. SPW 1 Spot Panel (Optional)</b>				
1	R50	028 769	POTENTIOMETER, C sltd sft 1/T 2W 750K ohm	1
2	R51	028 770	POTENTIOMETER, C sltd sft 1/T 2W 1 meg ohm	1
3	R52	028 768	POTENTIOMETER, C sltd sft 1/T 2W 350K ohm	1
4	S50	086 895	SWITCH, rotary 3 posn	1
5		073 914	WASHER, centering .437 dia	2
6	R53	605 890	RESISTOR, WW fxd 15W .25 ohm	1
7		080 509	GROMMET, scr No. 8/10 panel hole .312sq .375 high	3
8	PLG51	135 560	HOUSING PLUG & SOCKETS, (consisting of)	1
		079 747	· TERMINAL, contact hdr 24-18 wire	9
9	PLG 50	079 798	HOUSING, term hdr 13 pin	1
		079 747	TERMINAL, contact hdr 24-18 wire	13
10	PC50	097 897	CIRCUIT CARD, dual timer/pulser (Fig 11-7)	1
11	RC55	008 072	HOUSING PLUG & PINS, (consisting of)	1
		058 971	· TERMINAL, male 1 pin	8
12		086 650	PANEL, spot timer SKP-35	1
13		113 471	NAMEPLATE, (order by model and serial number)	1
14		097 922	KNOB, pointer	4

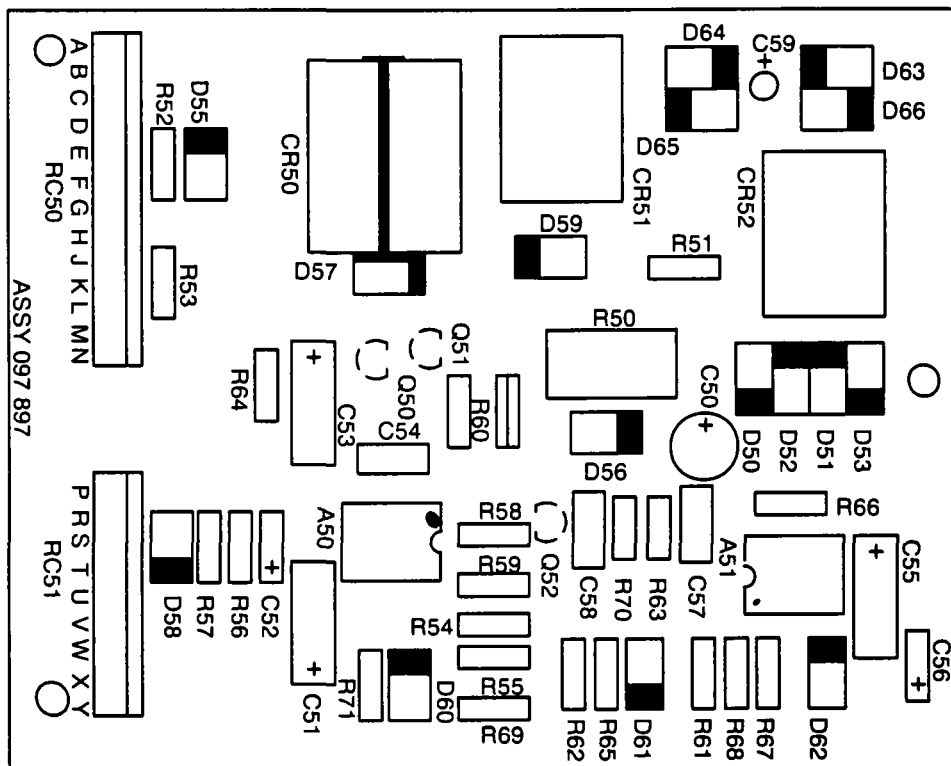


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**Figure 11-6. SPW 1 Spot Panel (Optional)**

**BE SURE TO PROVIDE MODEL AND SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS.**

Dia. Mkgs.	Part No.	Description	Quantity
<b>PC50</b>	<b>097 897</b>	<b>Figure 11-7. Circuit Card, Dual Timer/Pulser (Fig 11-6 Item 10)</b>	
A50,51	009 159	IC, linear 358	2
C50	039 482	CAPACITOR, elctlt 100uf 35VDC	1
C51,53,55	032 820	CAPACITOR tantlm 2.2uf 35VDC	3
C52,56	073 714	CAPACITOR tantlm .22uf 35V	2
C54,57,58	073 739	CAPACITOR cer mono .1uf 50VDC	3
C59	090 573	CAPACITOR, elctlt 10uf 50V	1
CR50	027 810	RELAY, encl 24VDC 4PDT	1
CR51	099 019	RELAY, encl 24VDC SPST	1
CR52	099 018	RELAY, encl 24VDC SPDT	1
	079 844	SPRING, hold down relay	1
	091 861	SOCKET, relay 14skt	1
D50-53,55,57-66	026 202	DIODE, rect 1A 400V SP	15
D56	037 449	DIODE, zener 15V 1W SP	1
Q50,51	037 200	TRANSISTOR, NPN 200MA 40V	2
Q52	073 535	TRANSISTOR, NPN 100MA 60V	1
R50	030 018	RESISTOR, C 1W 820 ohm	1
R51	035 823	RESISTOR, CF .25W 100 ohm	1
R52,71	035 884	RESISTOR, CF .25W 100K ohm	2
R53,57,61,68,70	039 331	RESISTOR, CF .25W 4.7K ohm	5
R54,56,59			
60,62,66,67	035 827	RESISTOR, CF .25W 10K ohm	7
R55,58	035 886	RESISTOR, CF .25W 22K ohm	2
R63	039 333	RESISTOR, CF .25W 18K ohm	1
R64,69	039 327	RESISTOR, CF .25W 220 ohm	2
R65	035 887	RESISTOR, CF .25W 3.3K ohm	1
	092 648	RESISTOR, WW fxd zero ohm	1
RC50	079 795	TERMINAL, hdr 13 pin	1
RC51	072 670	TERMINAL, hdr 9 pin	1

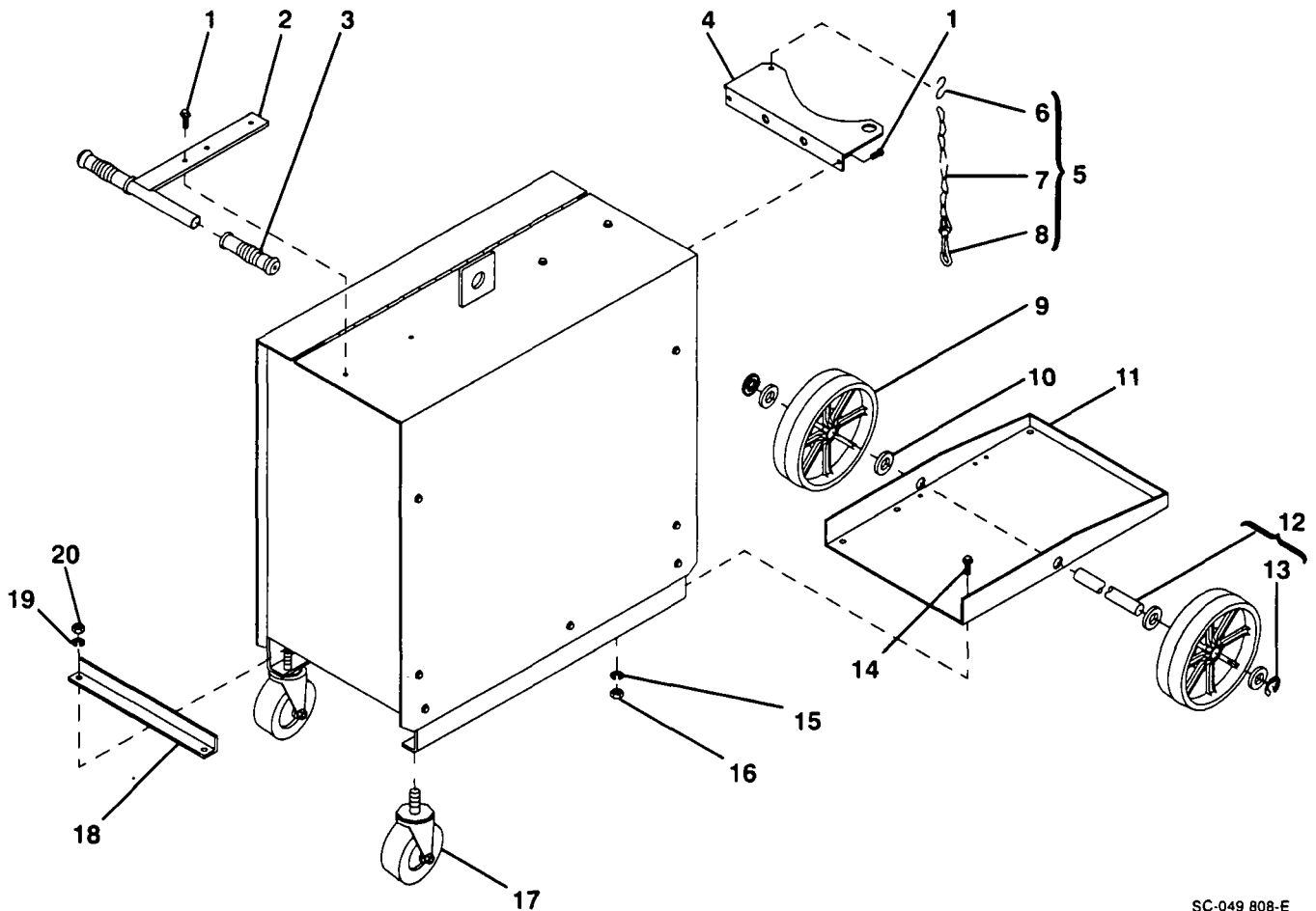


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**Figure 11-7. Circuit Card, Dual Timer/Pulser PC50**

**BE SURE TO PROVIDE MODEL AND SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS.**

Dia. Mkgs.	Part No.	Description	Quantity
<b>Figure 11-8. Running Gear</b>			
1	108 940	SCREW, cap stl hexwhd .250-20 x .750	4
2	025 193	HANDLE, running gear	1
3	604 423	GRIP, handle .875 ID x 4.500	2
4	057 478	BRACKET, support tank	1
5	022 617	CHAIN, cyl racks (consisting of)	1
6	602 389	· HOOK, S blunt 1.500 in	1
7	602 387	· CHAIN, weldless 2/0 x 27 in	1
8	602 384	· SNAP, chain	1
9	070 799	WHEEL, rubolene 10 in dia	1
10	602 250	WASHER, flat stl SAE .750	4
11	052 693	RACK, cylinder	1
12	052 692	AXLE, running gear (consisting of)	1
13	121 614	· RING, retaining ext .750 shaft x .082	2
14	601 944	SCREW, cap stl hexhd .312-18 x .750	4
15	602 211	WASHER, lock stl split .312	4
16	601 869	NUT, stl hex jam .312-18	4
17	008 999	CASTER, plastic swvl 4 in dia	2
18	052 691	ANGLE, spreader cyl rack	1
19	602 213	WASHER, lock stl split .375	2
20	601 871	NUT, stl hex jam .375-16	2



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**Figure 11-8. Running Gear**

BE SURE TO PROVIDE MODEL AND SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS.



